Avionics Interface Technologies

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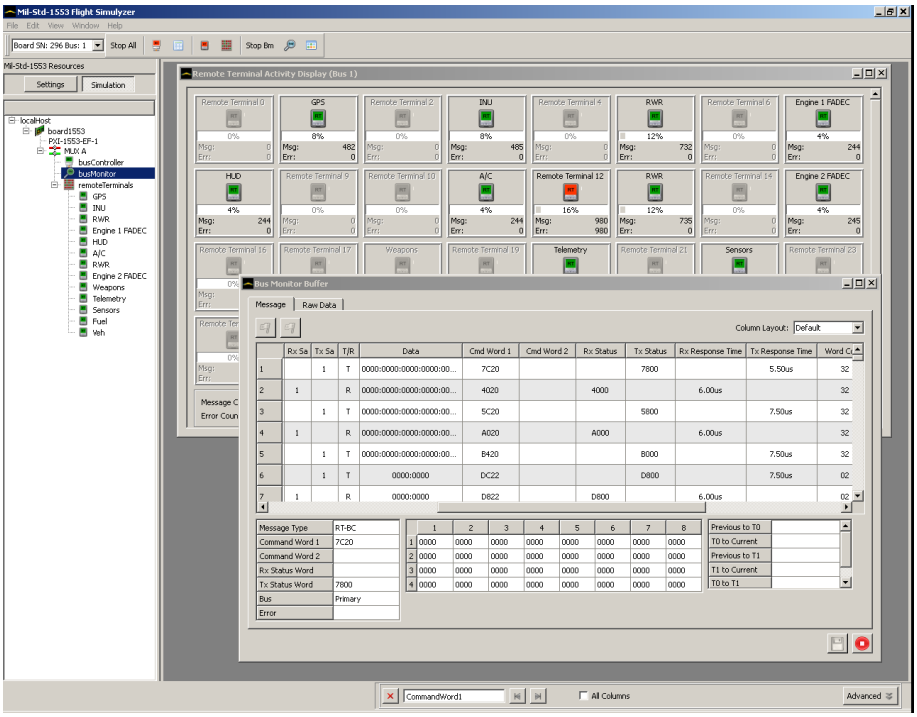
MIL-STD-1553 Graphical User Interface Analyzer/Simulator



April 2011

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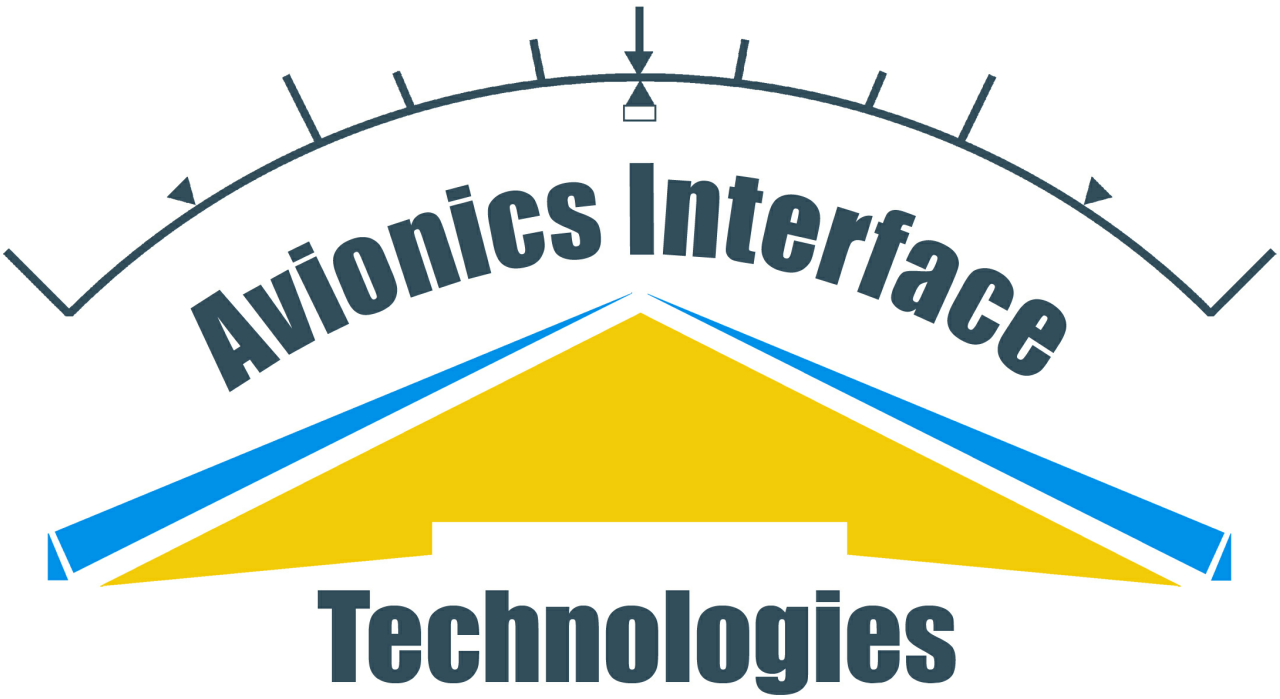


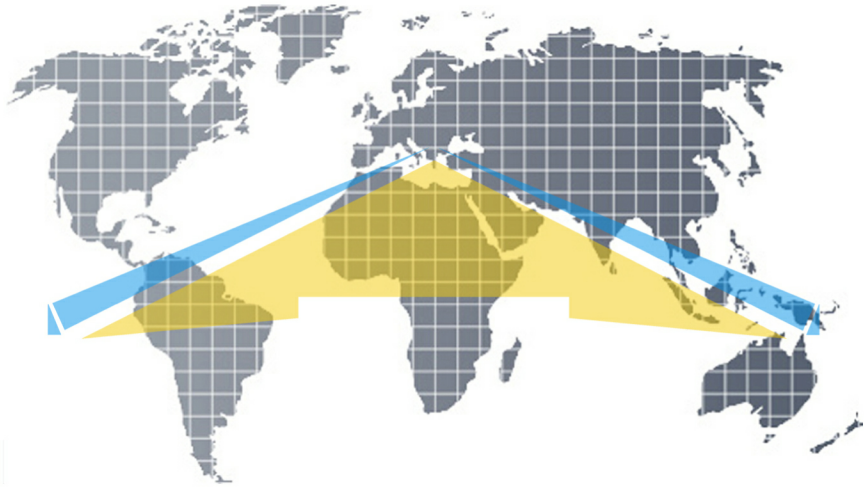
FlightScope Quick Start Guide

MIL-STD-1553 Graphical User Interface Analyzer/Simulator

v01.01.00

April 2011

>> Product Overview
>> MIL-STD-1553
>> PMC
>> XMC
>> PCI/PCI-X
>> PCIe
>> PXI/PXIe
>> cPCI
>> PC/104+
>> USB
>> VME
>> VXI
>> ARINC429
>> Combination 1553/429
>> ARINC664/AFDX
>> MIL-STD-1760
>> Fibre Channel
>> TTEthernet
>> TTP
>> Software Development Kit
>> Contact Us



Avionics Interface Technologies

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1 INTRODUCTION

1.1 General

This *Flight Simulyzer* 1553 User's Guide is designed to provide an unfamiliar user with a functional overview of the operation of AIT's Graphical User Interface (GUI) Analyzer Software. This manual presents the current version of AIT's *Flight Simulyzer* 1553 software from a feature overview through initial setup options.

Software installation of the Device Driver and Application Programmer's Interface (API) requirements are defined followed by a descriptive layout of the Main Window environment. The basic 1553 Bus Controller (BC), Remote Terminal (RT), and Chronological Bus Monitor (BM) functions are discussed in some detail to provide the user with a familiarity of the functionality of the software.

Document History

Version	Date	Author	Description
V01.00.00	March 2011	K. Bisson	Creation of document, written for *Flight Simulyzer* v01.1.0
V01.01.00	April 2011	T. Troshynski	Updated with additional information about BC, RT, BM operations.
V01.02.00	July 2011	J. Cole	Updated screenshots and added information for latest features.

1.2 How This Manual is Organized

This Manual is comprised of the following sections:

Section 1, **INTRODUCTION**, contains an overview of this manual.

Section 2, **FLIGHT SIMULYZER FEATURES**, describes AIT's *Flight Simulyzer* Software's advanced analyzer features.

Section 3, **INSTALLATION**, describes the steps required to install AIT's *Flight Sim*ulyzer Software.

Section 4, **STARTING FLIGHT SIMULYZER**, describes the steps required to start AIT's *Flight Simulyzer* and its Window layout.

Section 5, **BUS CONTROLLER**, describes AIT's *Flight Simulyzer*'s BC functions.

Section 6, **REMOTE TERMINAL**, describes AIT's *Flight Simulyzer*'s RT functions.

Section 7, **CHRONOLOGICAL BUS MONITOR**, describes AIT's *Flight Simulyzer*'s BM functions.

Section 8, **NOTES**, contains industry and product-specific definitions, acronyms and abbreviations.

1.3 Applicable Documents

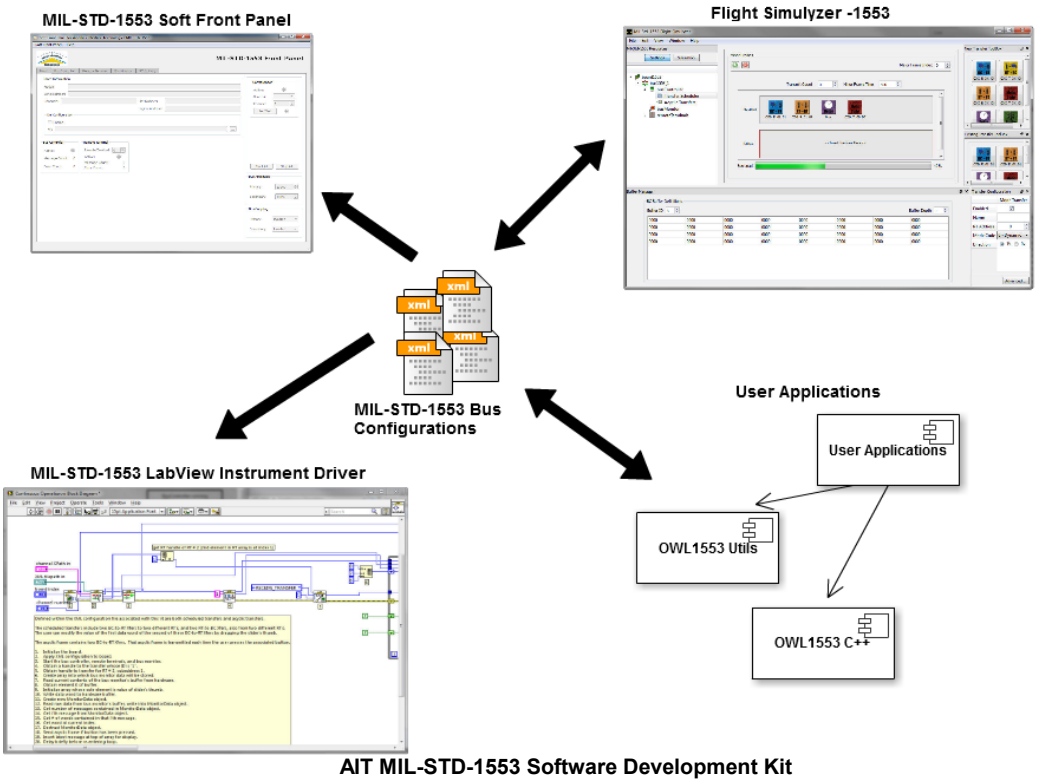
The following documents shall be considered to be a part of this document to the extent that they are referenced herein. In the event of conflict between the documents referenced and the contents of this document, the contents of this document shall have precedence.

- MIL-STD-1553B Digital Time Division Command/Response Multiplex Data Bus (US DOD Sept. 1978
- AIT MIL-STD-1553 Protocol Tutorial

2 FLIGHT SIMULYZER FEATURES

The *Flight Simulyzer* 1553 Analyzer Software is used in conjunction with AIT's family of 1553 interface boards to provide a powerful Windows-based 1553 Analyzer tool. An easy-to-use GUI allows complete visual programming that enables users to troubleshoot, optimize, plan and configure MIL-STD-1553 databuses. Low-level and high-level protocol analysis features work by capturing, filtering, time stamping and interpreting MIL-STD-1553 databus traffic and then generating advanced statistics for the users.

Flight Simulyzer's BC, RT and BM configurations are based on a common data format (XML) which allows simulation setups created and used within the *Flight Simulyzer* application to also be loaded and executed from within the AIT MIL-STD-1553 LabView instrument driver, high-level C++ and C# application interface libraries, and the MIL-STD-1553 soft front panel application. This allows configurations generated by *Flight Simulyzer* to be utilized from within user applications developed using LabView, C++, or C#.



AIT MIL-STD-1553 Software Development Kit

2.1 General Features

- Concurrent operation of multiple 1553 databuses and boards
- Time Correlation with Internal/External IRIG-B across Multiple 1553 databuses
- XML setup file for project, Bus Controller, Remote Terminal(s) and Bus Monitor setups
- Full access to 1553 databus memory associated with Bus Controller, Remote Terminal(s) and Bus Monitor
- Comprehensive Trigger and Filter capabilities (ie: on Bus Controller, on Remote Terminal and Bus Monitor data patterns within received data, errors, etc...)

2.1.1 Bus Controller Features

- Intuitive, easy-to-use user interface for defining major/minor framing schedules
- Full support for MIL-STD-1553 A/B mode code operations
- Full error injection, definable independently per BC command with full compliment of errors supported, including:
  - Command/Data word sync errors
  - Parity errors
  - Manchester encoding errors
  - Word/Bit count high/low errors
  - Gap time errors
  - Signal zero crossing errors
- Acyclic (on user command) data transfers
- View/Edit transfer buffers 'on-the fly'

2.1.2 Remote Terminal(s) Features

- Fully configure Tx/Rx buffers for each subaddress and mode code
- Define hardware controlled handling of status responses, including response time in microseconds
- Define response bus (independent of bus command received from)
- Full error injection configurable per RT subaddress with full compliment of errors supported, including:
  - Status/Data word sync errors
  - Word/Bit count high/low errors
  - Responses on wrong bus
  - Manchester encoding errors
  - Zero crossing errors
  - Gap time and parity errors
- Independently view and modify RT subaddress data 'on-the-fly'

2.1.3 Bus Monitoring Features

- Simple and/or complex start, stop, and strobe triggers
- Data filtering based on RT and subaddresses
- Illegal RT subaddress/mode code combinations to be flagged as errors by the BM
- Status word conditions to be flagged as errors by the BM

2.1.4 Replay Features

- Reconstruct 1553 databus traffic from recorded files in real-time
- Filter-specific Remote Terminal response from recorded file during reconstruction

3 INSTALLATION

3.1 Minimum System Requirements

- x86 300MHz CPU
- 128 MB RAM
- 30 MB available Hard disk space
- 500 MB available Hard disk space for recording
- Windows XP / Vista / 7
- Monitor resolution: 800 x 600 pixels with 256 colors

3.2 API Device Driver Requirements

AIT's *Flight Simulyzer* software requires properly installed AIT 1553 Device Drivers to operate correctly. During the installation process these drivers can be installed, or they may be installed separately.

Refer to the pertinent **AIT Hardware Manual** for details on installing the correct driver files for the specific Operating System.

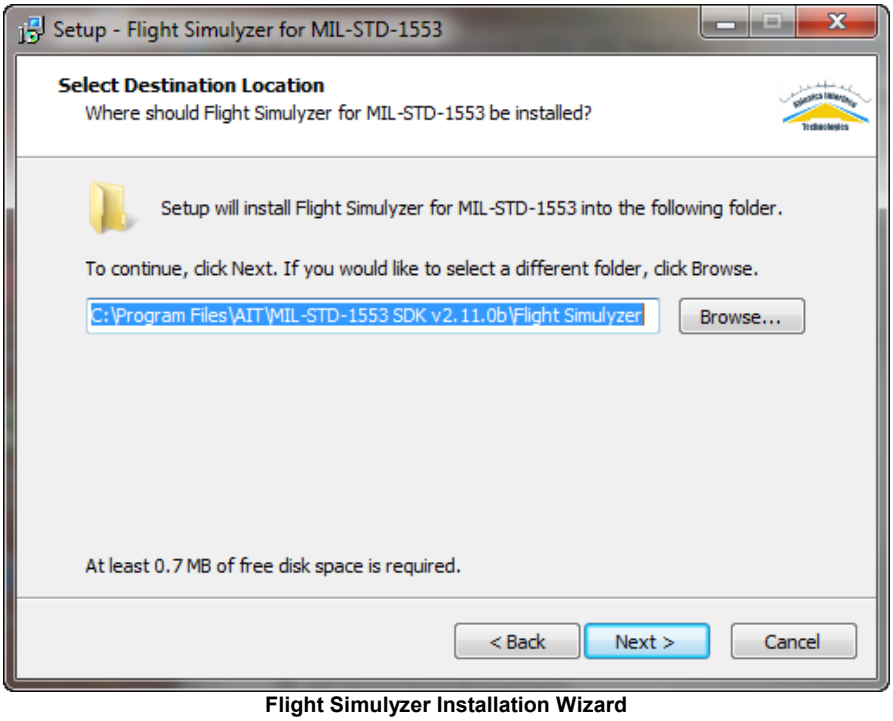
3.3 Flight Simulyzer Software Installation

- To install the *Flight Simulyzer* software:

  1. **Insert** the *Flight Simulyzer* CD into the CD ROM drive.

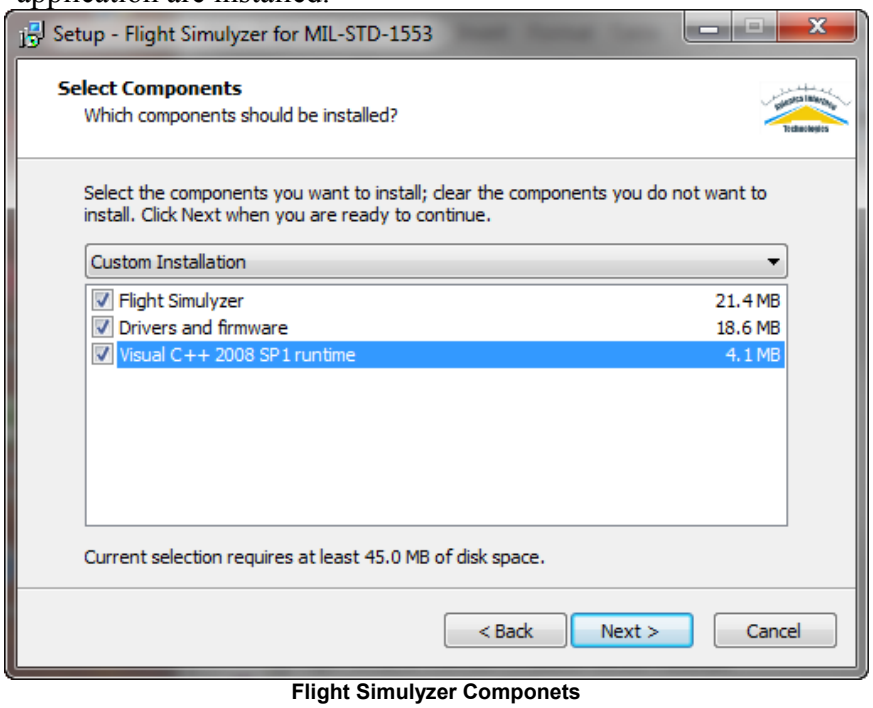
  2. After a few seconds, the *Flight Simulyzer* Setup application will automatically start. If the Setup application does not automatically start, you may manually start it by running the file fligth-simulyzer-x.x.x-win-pci**.exe** found on the *Flight Simulyzer* CD.

  3. Once the *Flight Simulyzer* Setup application has started, step through the **Install Wizard** to complete the installation. The wizard will give you the opportunity to choose the directory in which *Flight Simulyzer* is installed and the Program Folder in which the *Flight Simulyzer* shortcut will be placed. Default locations can also be used.


Setup - Flight Simulyzer for MIL-STD-1553
Select Destination Location
Where should Flight Simulyzer for MIL-STD-1553 be installed?
Setup will install Flight Simulyzer for MIL-STD-1553 into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
C:\Program Files\AIT\MIL-STD-1553 SDK v2.11.0b\Flight Simulyzer
Browse...
At least 0.7 MB of free disk space is required.
< Back
Next >
Cancel

Flight Simulyzer Installation Wizard

4. During installation, it is possible to select which components of the application are installed.


Setup - Flight Simulyzer for MIL-STD-1553
Select Components
Which components should be installed?
Select the components you want to install; clear the components you do not want to install. Click Next when you are ready to continue.
Custom Installation
Flight Simulyzer 21.4 MB
Drivers and firmware 18.6 MB
Visual C++ 2008 SP1 runtime 4.1 MB
Current selection requires at least 45.0 MB of disk space.
< Back
Next >
Cancel

Flight Simulyzer Componets

The table below summarizes the components of the Flight Simulyzer installation:

Component	Description
Flight Simulyzer	The GUI application and its supporting libraries and documents
Drivers and Firmware	The MIL-STD-1553 Hardware module drivers and firmware. If the Flight Simulyzer GUI is NOT going to be used with the hardware (i.e. it will only be used to create, export, and edit XML configurations) then this component may not need to be installed.
Visual C++ 2008 SP1 runtime	The Windows VC++ runtime required by the Flight Simulyzer application. This may be necessary if your host system is not updated to the latest OS service pack.

5. Once the installation is complete, a shortcut to the *Flight Simulyzer* application can be launched from the Start menu (**Start | All Programs | Avionics Interface Technologies | MIL-STD-1553 SDK vxx.xx.xx | Flight Simulyzer**).

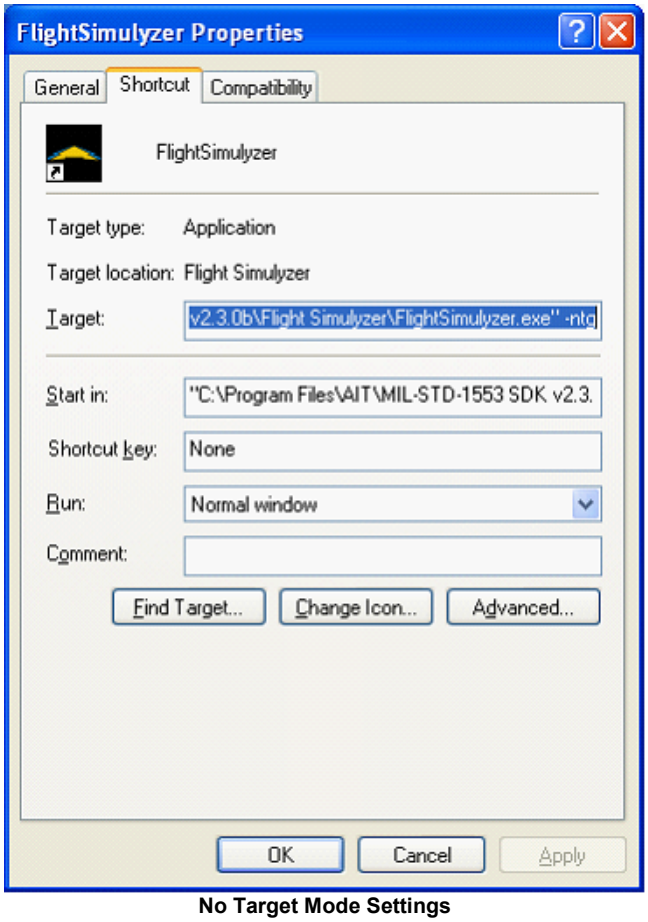
3.4 Using Flight Simulyzer without Hardware

- To use the *Flight Simulyzer* software without a MIL-STD-1553 hardware module present in the system:

  1. **Right click** on the installed *Flight Simulyzer* Desktop icon or system Start menu item and select **Properties**.

  2. **Add** *(space)*-ntg to the end of the target file name, as seen in the figure below. This enables the “No Target” mode of operation so that the *Flight Simulyzer* will now operate without having a MIL-STD-1553 board in the system.

If there is a 1553 board placed in the system, the –ntg option will not allow the *Flight Simulyzer* to access it. A message indicating “No Licensed Hardware Available” will appear in the Resource Status window. The "No Target" operation is useful to enable users to build setup xml files associated with Bus Controller, Remote Terminal(s), and Bus Monitor operation.



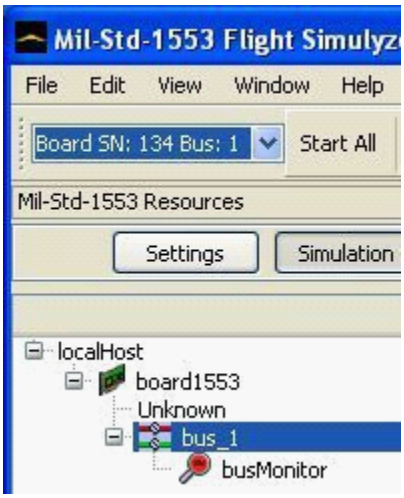
No Target Mode Settings

4 STARTING FLIGHT SIMULYZER

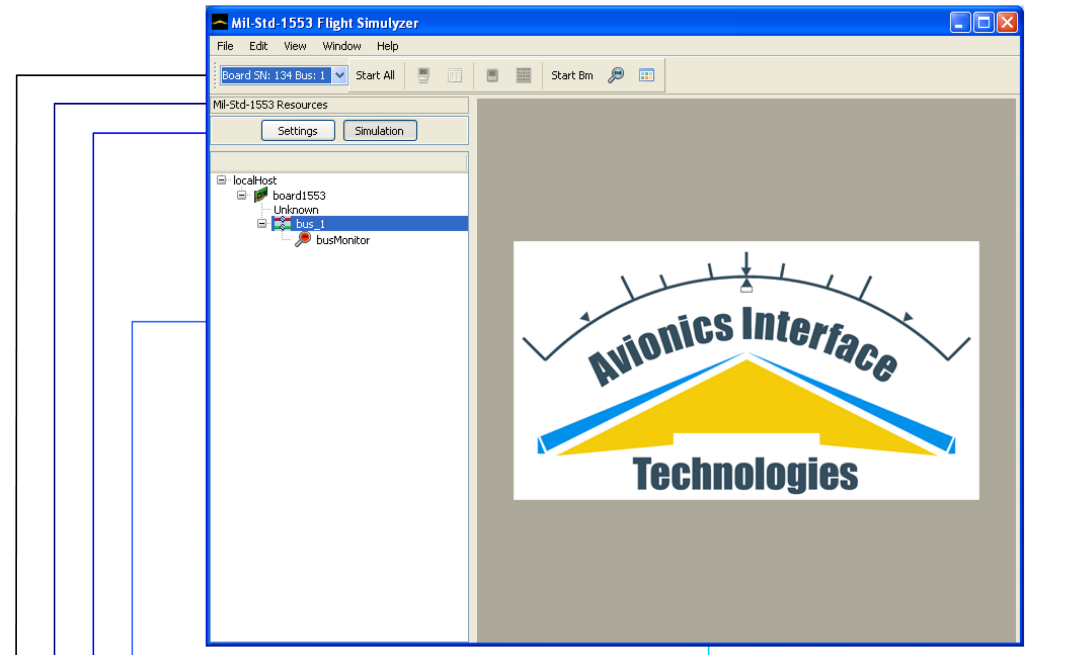
To begin using *Flight Simulyzer*, double click on the *Flight Simulyzer* icon that was placed on the Windows desktop or select *Flight Simulyzer* from **Start | All Programs | Avionics Interface Technologies | MIL-STD-1553 SDK vxx.xx.xx | Flight Simulyzer**.

Once *Flight Simulyzer* has been started, the **Main** graphics window is displayed. The software should automatically find the 1553 hardware. The status displayed looks like the example in the figure below. If no hardware is found, the correct license may not be installed correctly, or the "-ntg" mode is on, call AIT for support.

Main Window



***Flight Simulyzer* Window Layout**



Status

Detailed resource information based on the databus resource, this window changes for every function (i.e. BC, RT, and Bus Monitor)

Resource Status

Contains visual system information for the 1553 databus resource, in Simulation Mode displays the 1553 databus status

Settings

Settings button is used to setup the BC, RT, BM of the selected bus, Simulation button is used to start/stop the selected 1553 bus

Resource Display

Provides information about the resources found in the system and listed in Resource Status window

Menu Bar

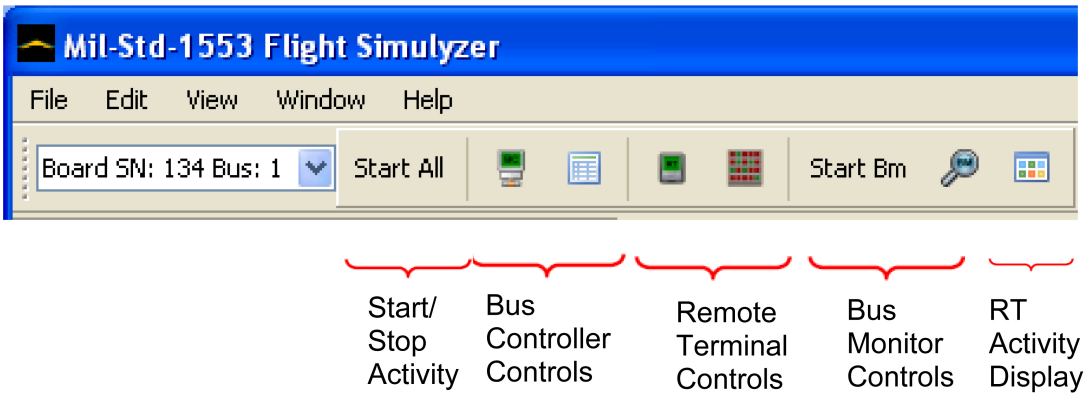
Provides all menu functions available for operations, also indicates the 1553 hardware found and available

4.1 Menu Bar

The Menu Bar provides access to **all** functions available for operation of the *Flight Simulyzer* Analyzer software. The Menu Button Bar has **quick access** icon groups available for the most commonly used functions. The Menu Bar and Menu Button Bar are shown below.

The Menu Buttons provide one-click access to setup BC, RT and BM functions, as well as Start/Stop activity and Display Remote Terminal Activity.

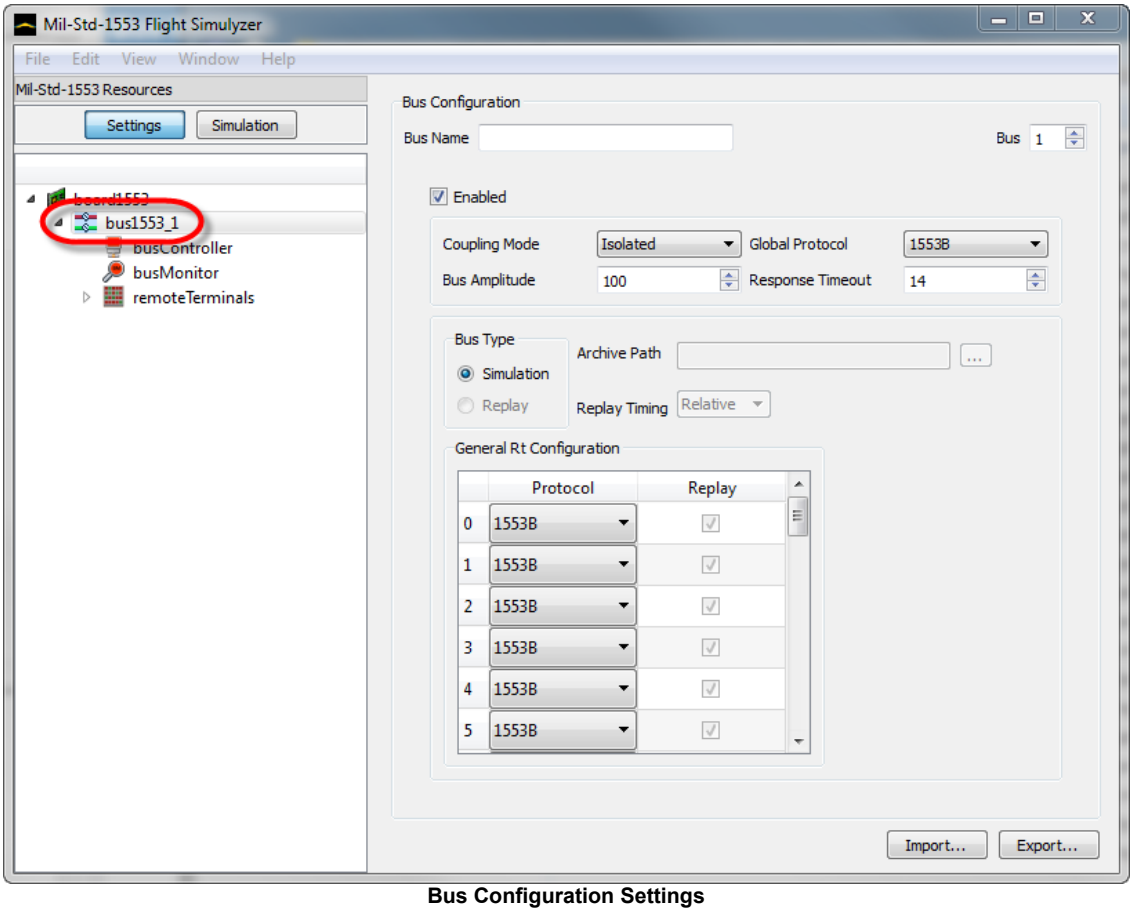
Menu Bar



5 MIL-STD-1553 BUS

5.1 Bus Settings

The MIL-STD-1553 Bus Interface configuration can be accessed by selecting a Bus (Channel) from the resource window.



Bus Configuration Settings

Each available MIL-STD-1553 Bus Interface of the hardware device can be individually configured. The following items are configurable:

- **Coupling Mode**: Specifies the electrical coupling mode used by the bus interface of the hardware devices. The available coupling modes are dependant on the MIL-STD-1553 hardware module.

Coupling Mode	Description
Isolated	The MIL-STD-1553 Bus interface of the hardware module is isolated from the front panel connector of the device. That is, it is isolated from the externally connected bus
Transformer	MIL-STD-1553 Transformer mode coupling
Direct	MIL-STD-1553 Direct mode coupling

External	The MIL-STD-1553 hardware device bus interface provides onboard emulation of a MIL-STD-1553 bus and an equivalent bus stub is provided at the front panel of the hardware device. This mode allows a transformer coupled device to be directly connected (without an external bus coupler) to the MIL-STD-1553 bus interface of the AIT device.
Loopback	The Digital Loopback mode provides an internal (onboard) loopback of the MIL-STD-1553 signal.
Fixed	The MIL-STD-1553 hardware device's bus interface is connected to the front panel connector of the device. The actual coupling mode is dependant on the mode(s) supported by the hardware device (i.e. Transformer or Direct)

- **Global Protocol**: Specifies whether the MIL-STD-1553A or MIL-STD-1553B protocol is used for the bus interface.
- **Bus Amplitude**: Specifies the voltage amplitude of the output bus signal of the MIL-STD-1553 device. Amplitude is specified as a percentage. The actual voltage is dependant on the specifications of the MIL-STD-1553 device. Only AIT Extended Function devices (PXI-C1553-EF, PCI-C1553-EF, PCIe-C1553-EF, and VXI-C1553T) support configurable bus amplitude.
- **Response Timeout**: Specifies the Remote Terminal response timeout in microseconds. This is the maximum time for an RT to resond to BC commands on this bus. If an RT does not respond to commands within this time, a *No Response* error is assumed (and reported by the BC and BM).

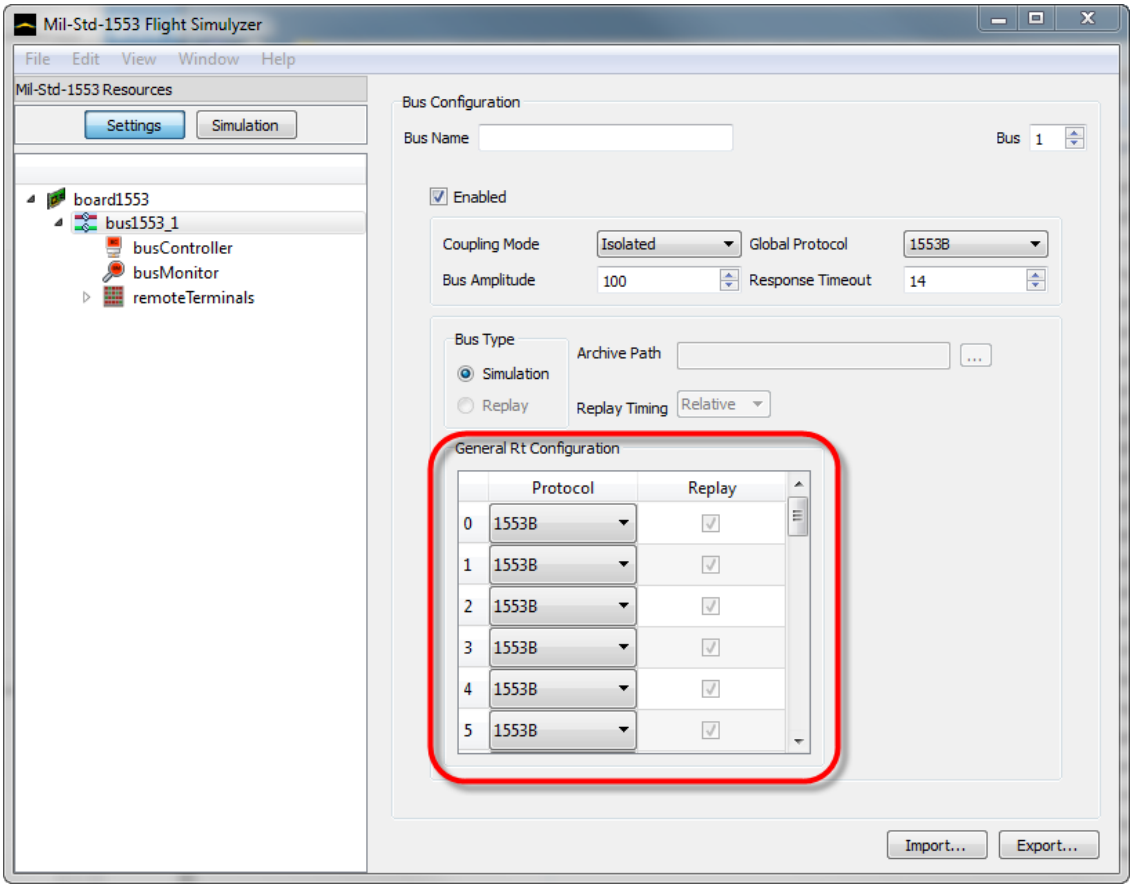
The operational mode of the MIL-STD-1553 Bus Interface can be selected in the bus settings.

- **Simulation**: This mode allows the configuration and simulation of the BC, RT(s), and the BM
- **Replay**: This mode allows a previously captured (by the BM) bus recording to be replayed on the bus interface

For each Remote Terminal of the bus interface, the MIL-STD-1553 protocol variant (1553A or 1553B) can be configured in the **General Rt Configuration** area. This setting dictates how the BC handles commands/responses for the RT and also how the BM interprets responses from the RT.

5.2 Bus RT Protocol

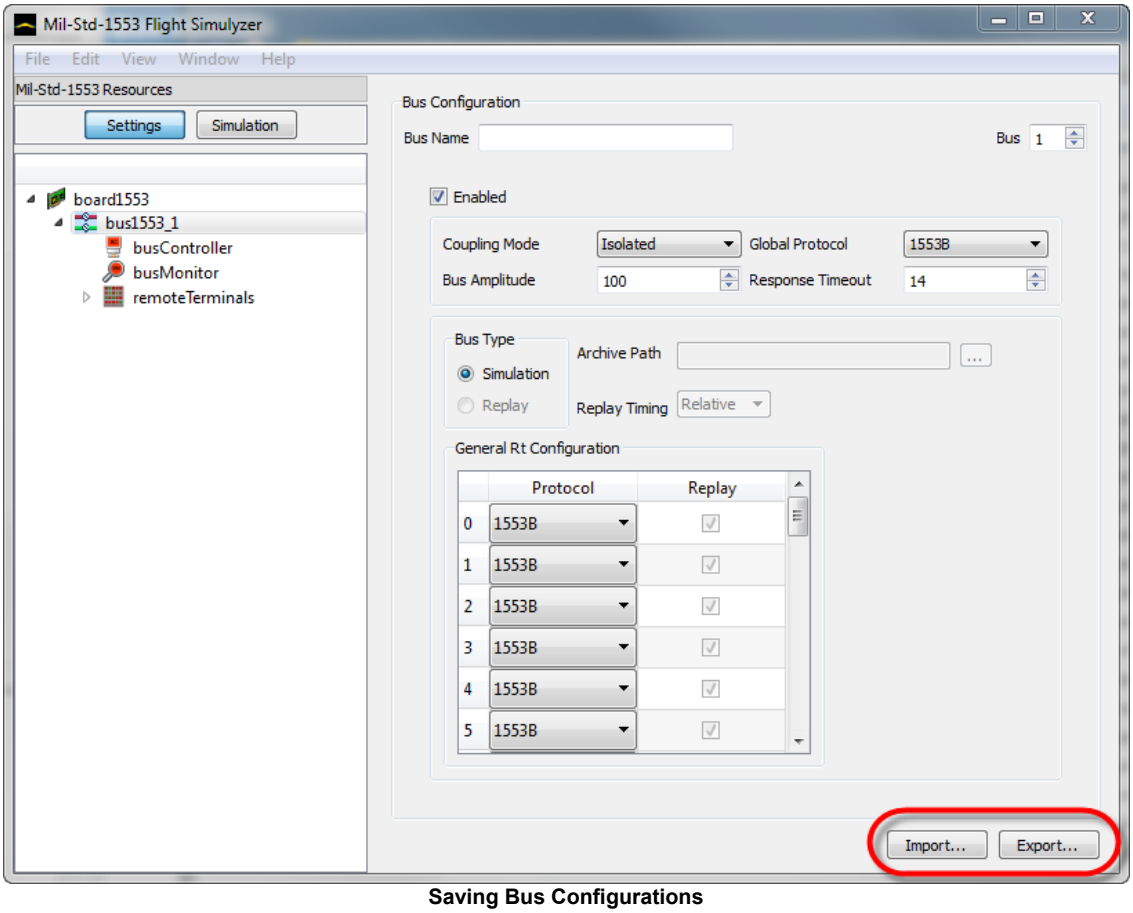
For each Remote Terminal of the bus interface, the MIL-STD-1553 protocol variant (1553A or 1553B) can be configured in the **General Rt Configuration** area. This setting dictates how the BC handles commands/responses for the RT and also how the BM interprets responses from the RT.



RT Bus Protocol Settings

5.3 Saving Bus Setup Information

The Bus setup information can be saved as an xml file, or alternatively as a binConfig file. If you highlight the Bus Interface node in the resource tree, import and export buttons appear in the lower right hand corner.



Saving Bus Configurations

Clicking the Export button will enable you to save the setup configuration of the Bus interface. The Bus Interface setup configuration includes the setup configuration information of all components, including the BC, RT(s), and BM setup configurations. If the XML file format is used, the xml file can be edited using any xml browser/editor. The binConfig file format should be used when exporting if it will be used in a LabVIEW Real-Time target.

The Import button enables you to import the Bus setup information.

6 BUS CONTROLLER

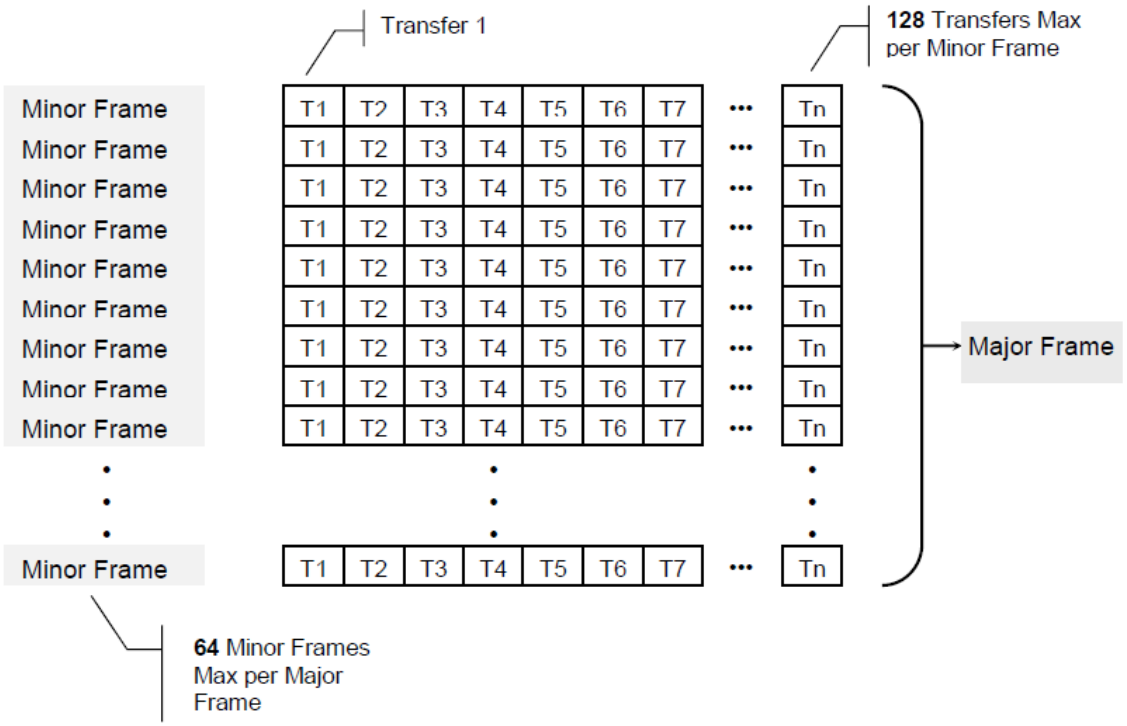
The main function of the Bus Controller (BC) is to provide data flow control for all transfers on the 1553 databus.

The BC must initiate and coordinate the transfer of information on the data bus. All information is communicated in command/response mode. The BC sends a command to the RTs, which reply with a response.

Setting up the BC involves defining individual 1553 transfers. These defined transfers are then grouped together to create Minor Frames. From this group of Minor Frames, Major Frames are constructed.

Multiple Transfers make up a Minor Frame, and any Transfer can be used multiple times. Multiple Minor Frames make up a Major Frame, with any Minor Frame able to be used multiple times as well.

Figure 5 - Frame Topology

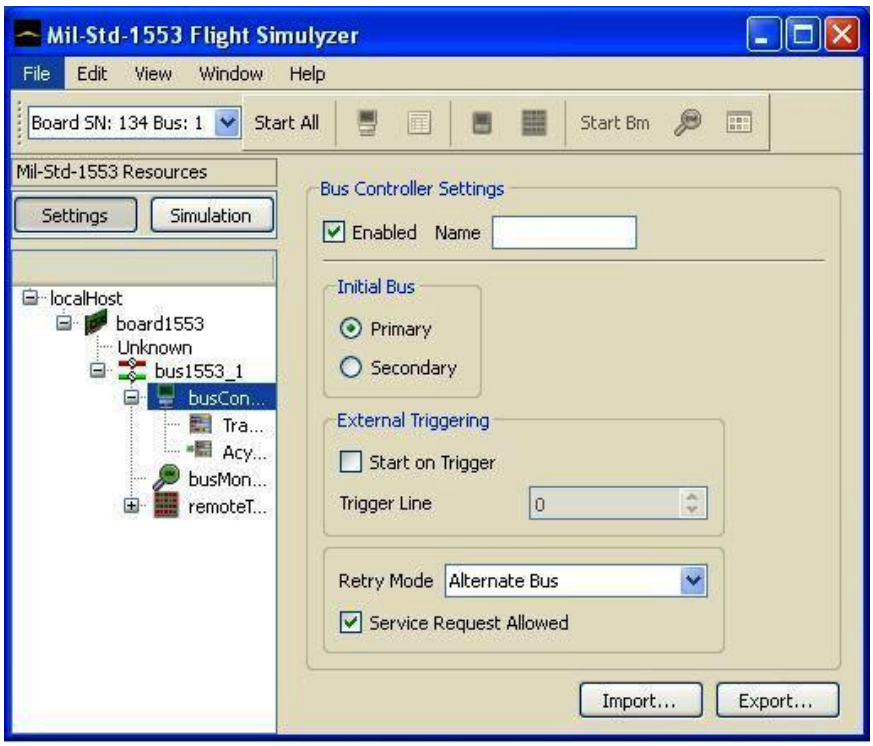

Transfer 1
128 Transfers Max per Minor Frame
Minor Frame
T1 T2 T3 T4 T5 T6 T7 ••• Tn
Major Frame
64 Minor Frames Max per Major Frame

6.1 BC Transfers Setup

- To set up BC Transfers:

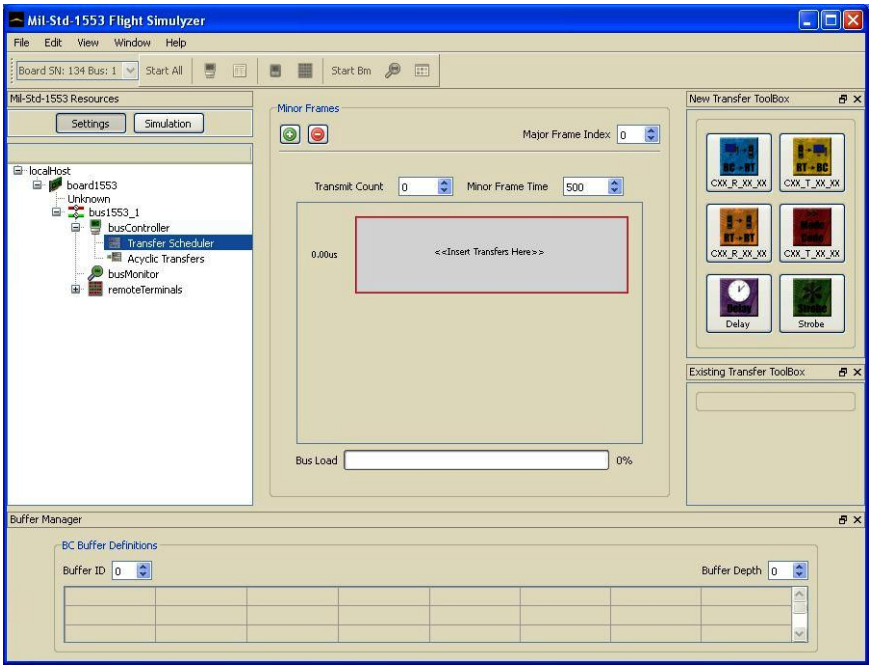
1. Select the **Settings** button from the main screen and highlight **buscontroller** in the resource window. Make sure the Bus Controller is enabled by checking the box next to **Enabled**, as seen below.

Bus Controller Settings menu



2. Next, highlight the **Transfer Scheduler**. The BC transfer scheduler window (shown below) will appear and you can start constructing your transfers.

BC Transfer Scheduler



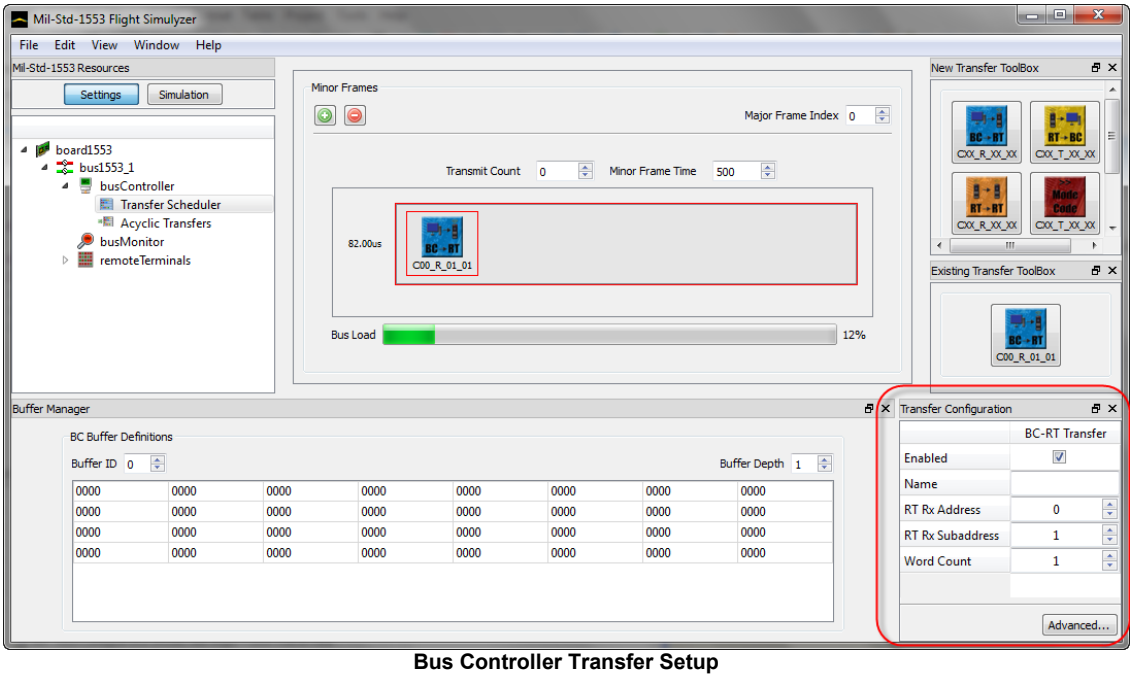
6.1.1 Creating BC to RT Transfers

- To set up a BC to RT Transfer:

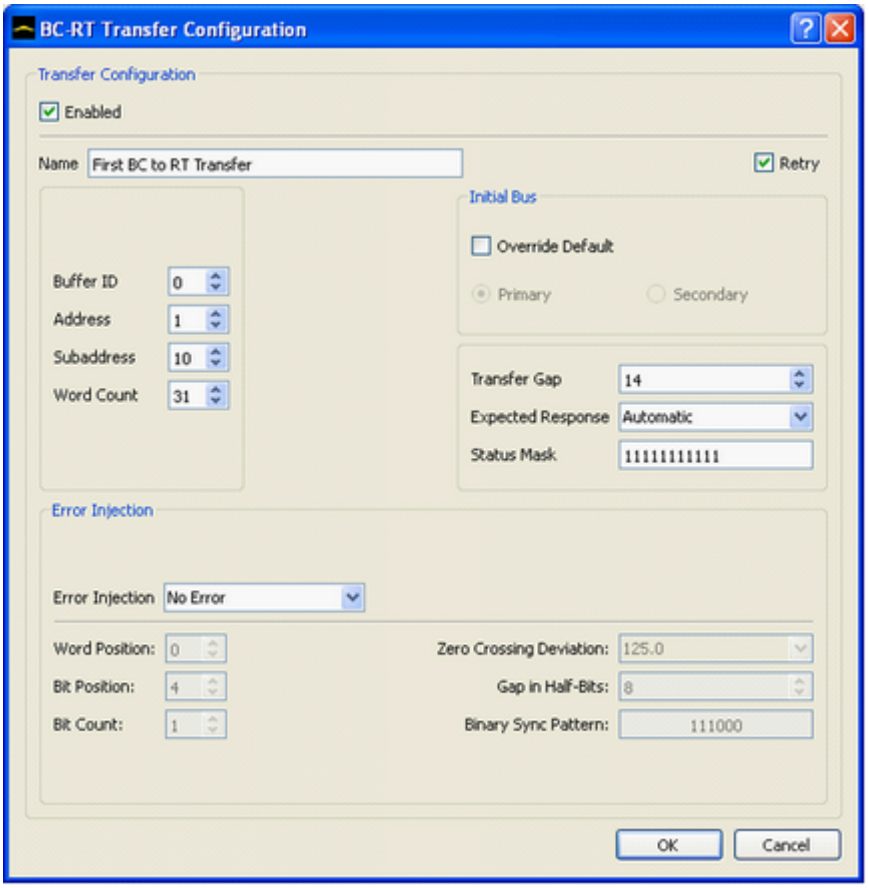
1. Click on the blue **BC – RT icon** and drag it from the **New Transfer** toolbox into the red **Minor Frame** box.

BC-RT Transfer Icon

2. Select the BC – RT icon in the Minor Frame box and then enter the transfer data in the Transfer Configuration area. Advanced Transfer Configuration details (i.e. Error Injection) may be entered by selecting the Advanced... button of Transfer Configuration area.



Bus Controller Transfer Setup



BC Transfer Details

For BC - RT Transfers, the following items may be configured:

- Name: user-defined name associated with this transfer
- Buffer ID: ID number of the data buffer associated with this transfer (Note: data inserted in this buffer can be defined in the previous menu)
- Address: RT address
- Subaddress: RT subaddress
- Word Count: number of data words associated with this transfer
- Retry check box: whether this transfer should be tried again if an error occurs
- Override Default: check box to indicate if the transfer should be sent over primary or secondary channel based on default configuration setup
- Transfer Gap: the time from the start of this message to the next (in milliseconds)
- Expected Response: the expected response from the RT, choices are automatic and 2 user-defined status words
- Status Mask: the status word exception mask bits (1 = accept, 0 = disregard)
- Error Injection: this section is used to turn on specific 1553 protocol and waveform errors associated with the transfer

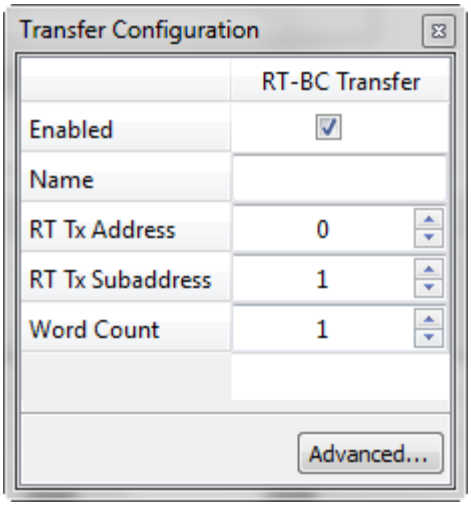
6.1.2 Creating RT to BC Transfers

- To set up an RT to BC Transfer:

1. Click on the yellow **RT – BC icon** and drag it from the **New Transfer** toolbox into the red **Minor Frame** box.

RT - BC Icon

2. Select the RT – BC icon in the Minor Frame box and then enter the transfer data in the Transfer Configuration area. As with the BC - RT transfers, advanced configurations (including error injection) are possible by selecting the Advanced... button of the Transfer Configuration area.



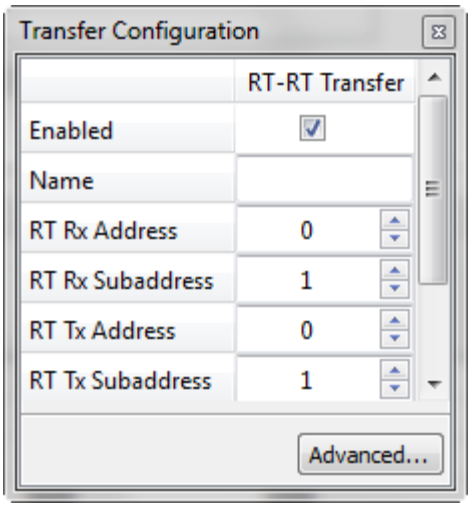
6.1.3 Creating RT to RT Transfers

- To set up an RT to RT Transfer:

1. Click on the orange **RT to RT icon** and drag it from the **New Transfer** toolbox into the red **Minor Frame** box.

RT - RT Icon

2. Select the RT – RT icon in the Minor Frame box and then enter the transfer data in the Transfer Configuration area. As with the BC - RT transfers, advanced configurations (including error injection) are possible by selecting the Advanced... button of the Transfer Configuration area.



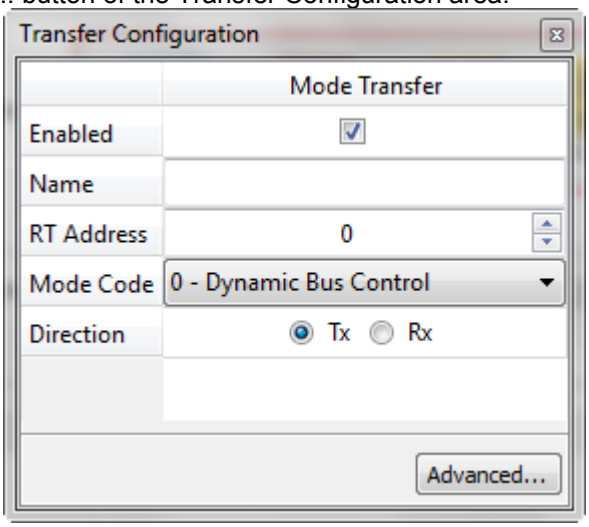
6.1.4 Creating Mode Code Transfers

- To set up a Mode Code Transfer:

1. Click on the red **Mode Code icon** and drag it from the **New Tr**ansfer toolbox into the red **Minor Frame** box.

Mode Code Transfer Icon

2. Select the Mode Code icon in the Minor Frame box and then enter the transfer data in the Transfer Configuration area. As with the BC - RT transfers, advanced configurations (including error injection) are possible by selecting the Advanced... button of the Transfer Configuration area.



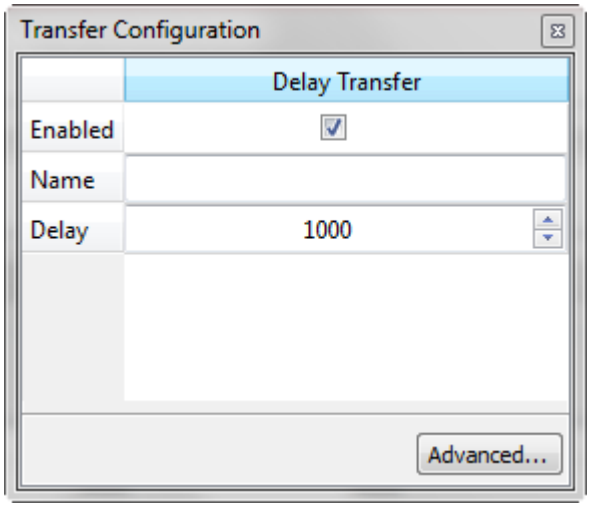
6.1.5 Add a Delay to the Schedule

· To add a Delay to the Schedule:

1. Click on the purple Delay icon and drag it from the New Transfer toolbox into the red Minor Frame box.

Delay Icon

2. Select the Delay icon in the Minor Frame box to setup a delay within the Minor Frame within the Transfer Configuration area. The Delay can be set up to 16,000 microseconds.



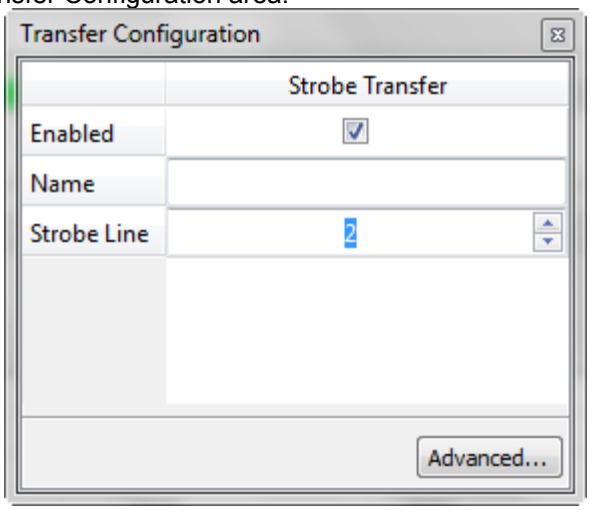
6.1.6 Using Strobe

· To set up Strobe:

1. Click on the green Strobe icon and drag it from the New Transfer toolbox into the red Minor Frame box.

Strobe Icon

2. Select the Strobe icon in the Minor Frame box to setup an output strobe line within the Transfer Configuration area.



Strobe Transfer Configuration

6.2 Setting Up Minor Frames

- To setup Bus Control Minor Frames:

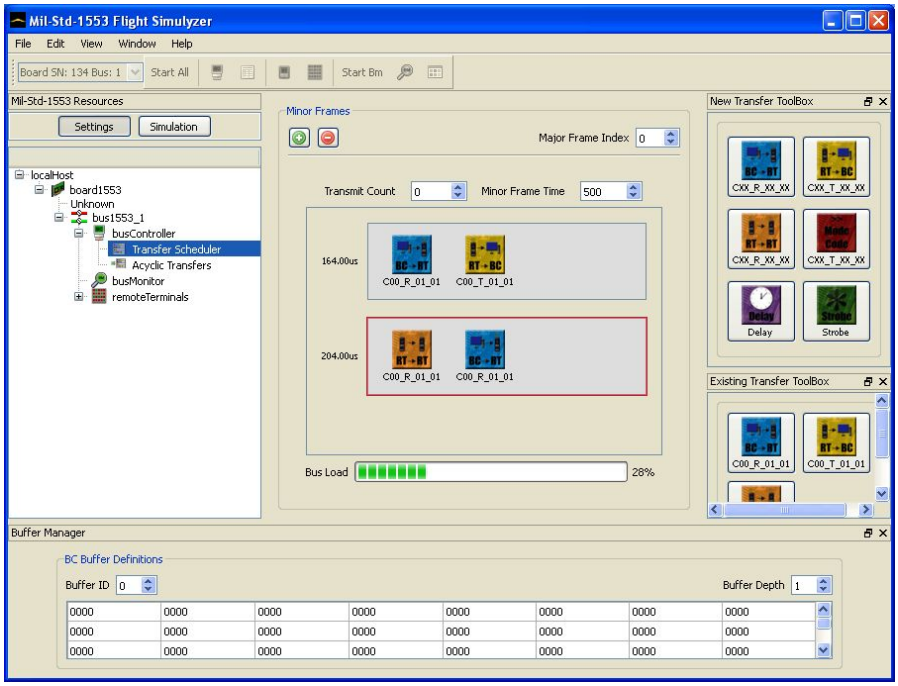
1. In the **Bus Controller Scheduler** window locate the **Minor Frames** buttons:

2. Use these buttons to add or delete Minor Frames.

When you add another Minor Frame an additional frame appears as an additional rectangle in the Frame Scheduler window. You can highlight any Minor Frame to work on the transfers contained within it. The highlighted Minor Frame will have a red rectangle around it.

The transmit count value refers to how many times all of the Minor Frames contained in the Major frame will be sent. A value of "0" means send the same Major Frame continuously.

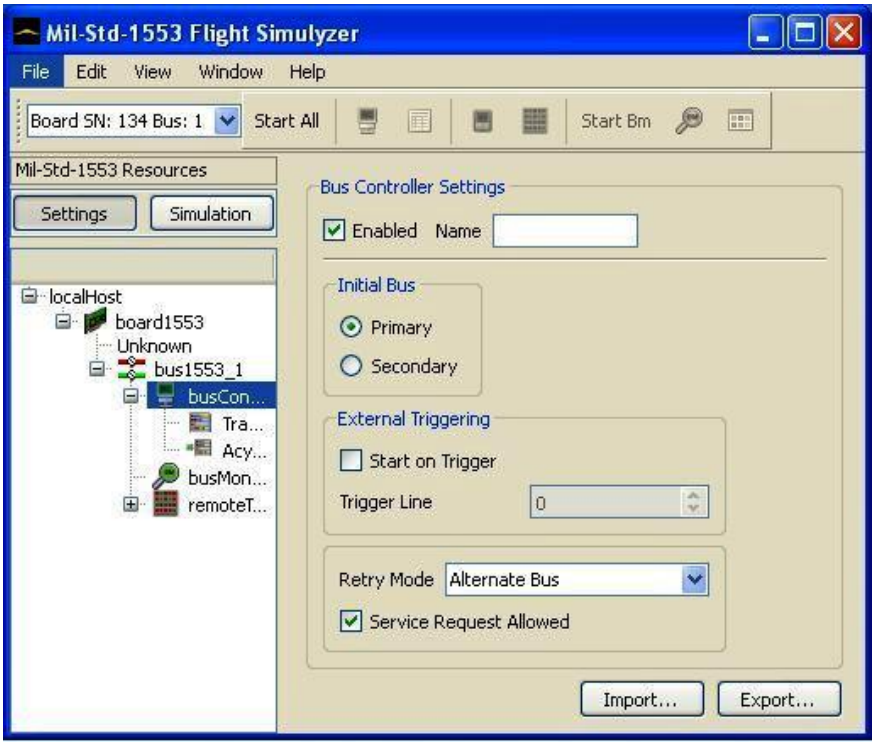
Select a Minor Frame



6.3 Saving Bus Controller Setup Information

The Bus Control setup information can be saved as an xml file, or alternatively as a binConfig file. If you highlight the busController in the resource window, import and export buttons appear in the lower right hand corner.

Figure 5.3 - Bus Controller Settings



Clicking the Export button will enable you to save the setup configuration of the Bus Controller. If the XML file format is used, the xml file can be edited using any xml browser/editor. The binConfig file format should be used when exporting if it will be used in a LabVIEW Real-Time target.

The Import button enables you to import the Bus Controller setup information.

6.4 Starting the Bus Controller

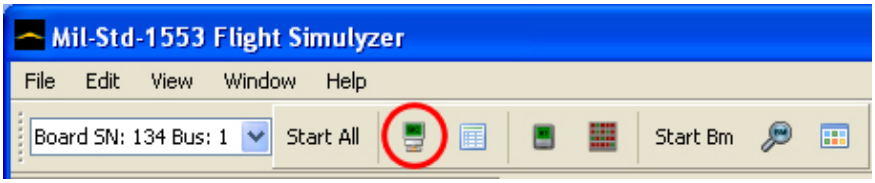
- To start the Bus Controller:

  1. Press the **Simulation** button. The 1553 resources screen enables you to start the Bus Controller by doing one of the following:

     - Right click on **busController** in the resource pane, and choose **Start BC**.

     - Click on the **Bus Controller** icon in the Menu Bar, shown in the red circle below.

Figure 5.4 - Bus Controller Icon

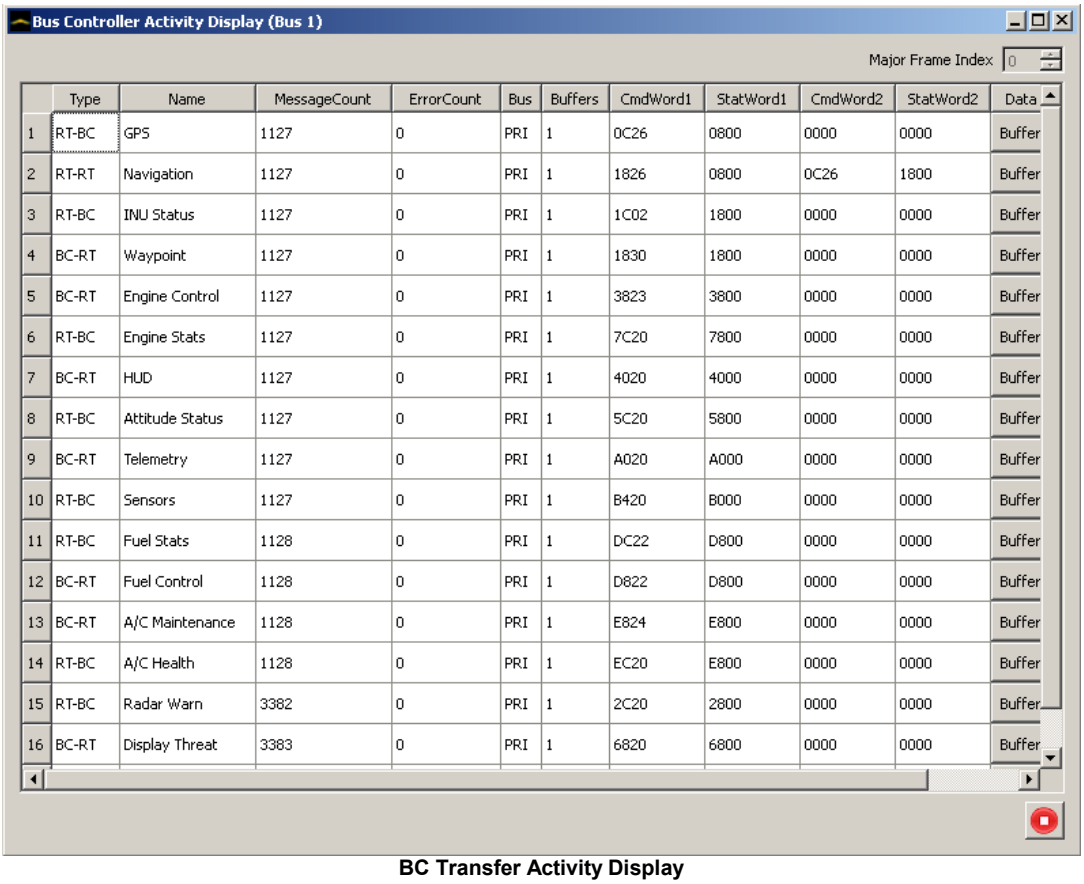


Note: The Start All button enables you to start the BC, Remote Terminals, and Bus Monitor using a single button.

6.5 Operating the Bus Controller

After the BC has been started, it is possible to view the status of the BC Transfers of the currently active Major Frame.

- To view the active BC Transfers
  1. Right click over the busController icon in the resource tree.
  2. This will open the BC Activity Display which is shown below.



	Type	Name	MessageCount	ErrorCount	Bus	Buffers	CmdWord1	StatWord1	CmdWord2	StatWord2	Data
1	RT-BC	GPS	1127	0	PRI	1	0C26	0800	0000	0000	Buffer
2	RT-RT	Navigation	1127	0	PRI	1	1826	0800	0C26	1800	Buffer
3	RT-BC	INU Status	1127	0	PRI	1	1C02	1800	0000	0000	Buffer
4	BC-RT	Waypoint	1127	0	PRI	1	1830	1800	0000	0000	Buffer
5	BC-RT	Engine Control	1127	0	PRI	1	3823	3800	0000	0000	Buffer
6	RT-BC	Engine Stats	1127	0	PRI	1	7C20	7800	0000	0000	Buffer
7	BC-RT	HUD	1127	0	PRI	1	4020	4000	0000	0000	Buffer
8	RT-BC	Attitude Status	1127	0	PRI	1	5C20	5800	0000	0000	Buffer
9	BC-RT	Telemetry	1127	0	PRI	1	A020	A000	0000	0000	Buffer
10	RT-BC	Sensors	1127	0	PRI	1	B420	B000	0000	0000	Buffer
11	RT-BC	Fuel Stats	1128	0	PRI	1	DC22	D800	0000	0000	Buffer
12	BC-RT	Fuel Control	1128	0	PRI	1	D822	D800	0000	0000	Buffer
13	BC-RT	A/C Maintenance	1128	0	PRI	1	E824	E800	0000	0000	Buffer
14	RT-BC	A/C Health	1128	0	PRI	1	EC20	E800	0000	0000	Buffer
15	RT-BC	Radar Warn	3382	0	PRI	1	2C20	2800	0000	0000	Buffer
16	BC-RT	Display Threat	3383	0	PRI	1	6820	6800	0000	0000	Buffer

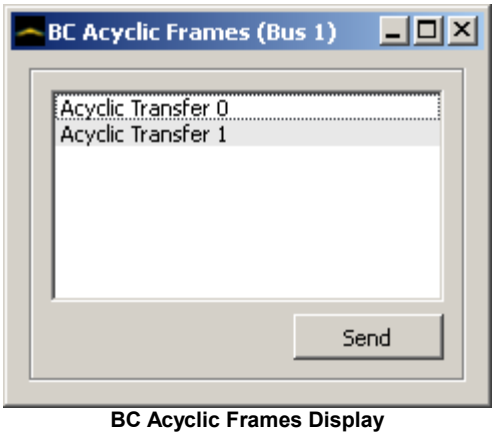
BC Transfer Activity Display

Several BC Operations are possible from inside the BC Activity Display window:

1. The BC can be started and stopped using the button at the lower right corner of the window.
2. The contents of the buffer associated with a transfer can be viewed (or edited) by selecting the Buffer button located in the Data column of the display for each transfer.
3. Status information for each individual transfer may be viewed. This includes the message and error count and additional information.

6.6 Sending Acyclic Frames

- To send an Acyclic frame via the BC
  1. Right click over the **busController** in the resource tree, then select **Show BC Acyclic Frames Display**
  2. In the BC Acyclic Frames Display, select the Acyclic transfer to be sent, the press the **Send** button.



BC Acyclic Frames Display

7 REMOTE TERMINAL

The main function of the Remote Terminal (RT) is to provide the information, including data, for all remote terminals that will be simulated by the AIT board on the 1553 databus.

The RT is a device designed to interface with various subsystems on the 1553 databus. The interface device may be embedded within the subsystem itself, or may be an external interface to tie a non-1553 compatible device to the bus. As a function of the interface requirement, the RT receives and decodes commands from the BC, detects any errors and reacts to those errors. The RT must be able to properly handle both protocol errors (missing data, extra words, etc.) and electrical errors (waveform distortion, rise time violations, etc). RT's are the largest segment of bus components. Up to 31 remote terminals can be connected to the data bus and each remote terminal can have 31 subadresses. The remote terminal shall not speak unless spoken to first by the bus controller and specifically commanded to transmit. The commands may include data or request for data (including status) from RT's Command word, Data word and Status word formats.

Remote Terminal setup consists of setting up the following three components in the following order:

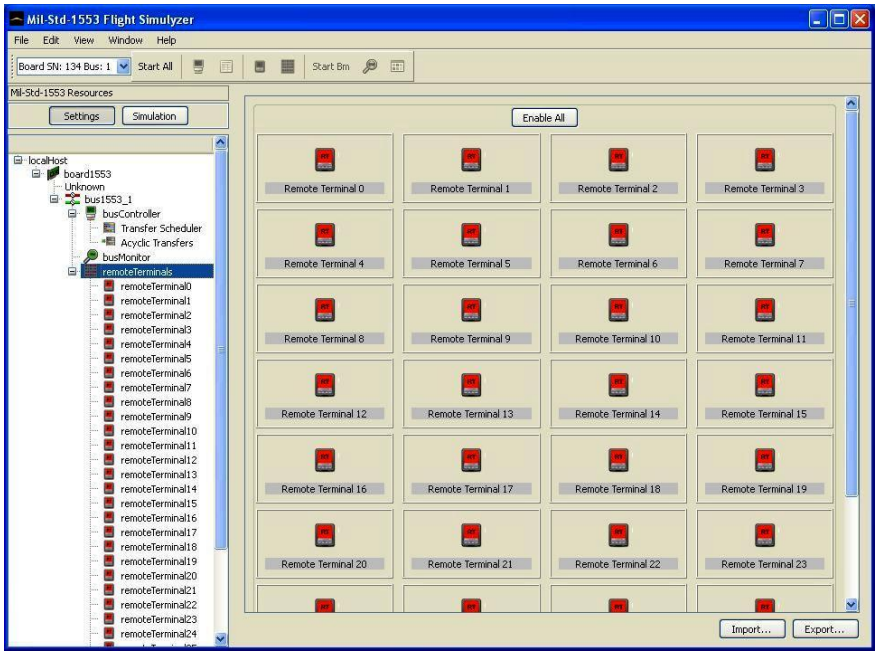
- Setup Remote Terminal
- Setup the RT Subaddress or Mode Code
- Setup the data associated with RT/SA transmission

7.1 Remote Terminal Setup

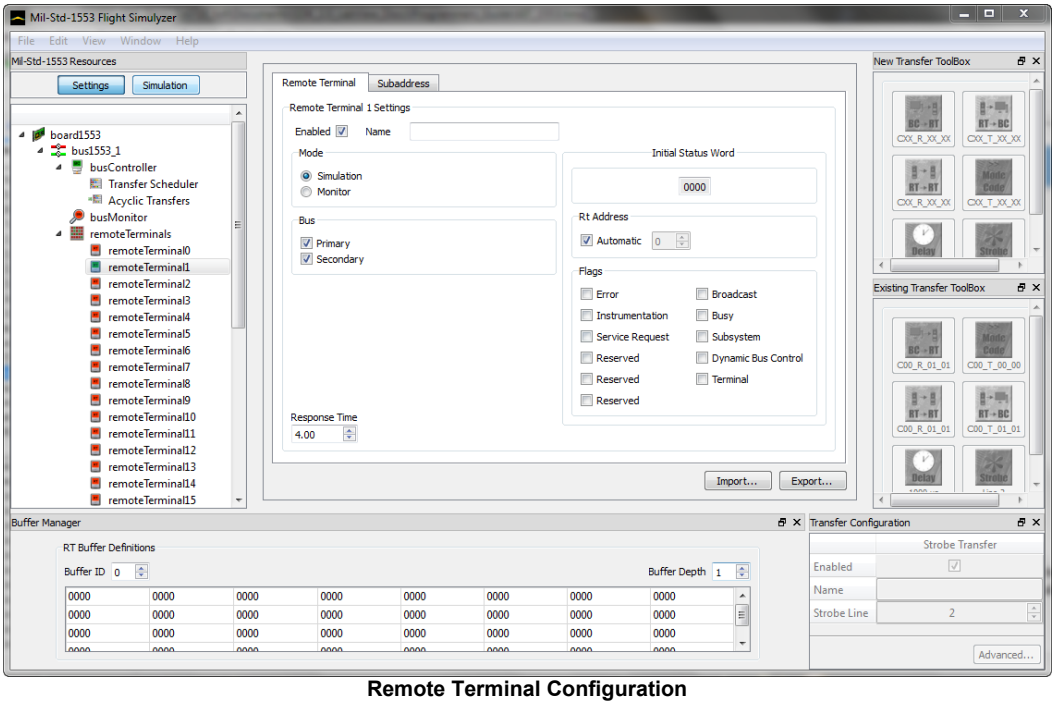
- To setup the Remote Terminal(s):

    1. Select the **Settings** button from the main screen and highlight **remoteTerminals** in the resource window. The menu tree expands and displays all 31 possible Remote Terminals that can be simulated, as seen below:

Remote Terminal Settings



Select any of the Remote Terminal address' that you wish to simulate by selecting them in the resource window. Once you have selected the Remote Terminal, the Remote Terminal Settings windows will appear in the right pane. Check the **Enable** box to simulate the Remote Terminal.



Remote Terminal Configuration

You have the following options that can be set in this window:

Mode

- Simulation: simulate the Remote Terminal, meaning the AIT board will respond on the 1553 databus as a Remote terminal when commanded by the Bus Controller.
- Monitor: monitor all RT activity, but do not respond with an RT status word databus as a Remote terminal would when commanded by the Bus Controller. This is useful for test applications when you want to monitor RT activity, while having the "real" RT also connected to the 1553 databus.

Bus

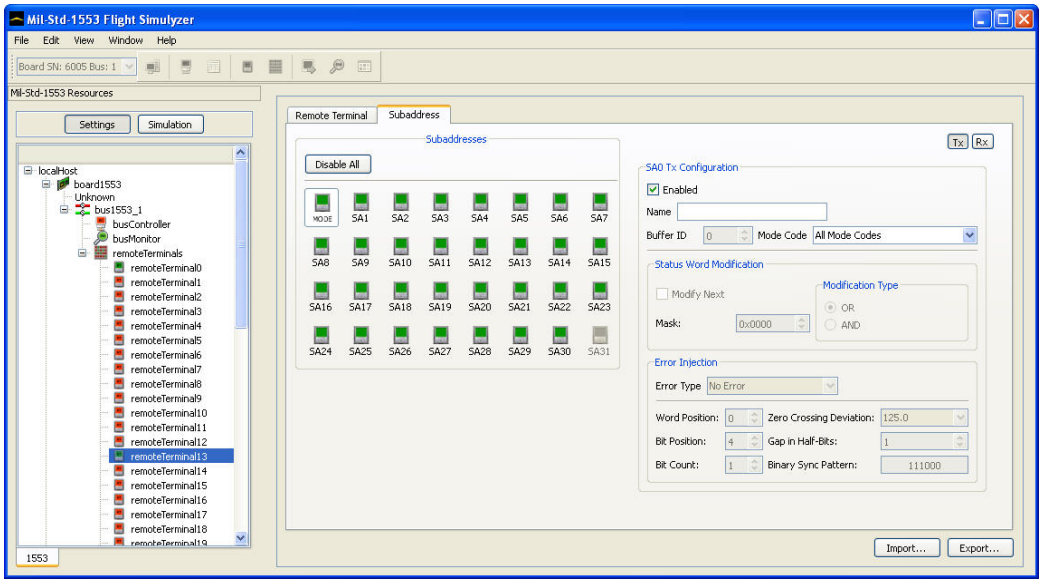
- Primary: respond on the primary bus
- Secondary: respond on the secondary bus (Note: if both are checked then respond to any command when received on either bus)
- Response Time: The time used to respond to the Bus Controller Command
- Initial Status Word: the value (in hex) of the status word response
- RT Address: the RT address that will be used in the RT response word
- Flags: the flag bits that can be optionally set in the status word response

7.2 Setup RT Subaddress and Mode Code

- To setup the Remote Terminal subaddress:

1. Select the **Subaddress** folder tab. The menu page will change from the RT to the **Subaddress Settings** window, as shown below:

Figure 6.2 - Subaddress Tab



Two examples are below.

- To enable Receive Subaddress (SA) 2 to receive 3 data words by:

  1. Optionally enter a name to associate with the Subaddress transfer.

  2. Select the **SA03** icon in the left window.

  3. Select the **Rx** button in the upper right corner (choice is Tx or Rx).

  4. Check the **Enable** box.

  5. Select the **Rx Buffer Id**, and the size of the buffer to store the Received data.

- To setup RT01 SA10 to transmit 7 data words:

  1. Optionally enter a name to associate with the Subaddress transfer.

  2. Click on the **remote terminal 03** under the **remoteTerminals** resource in the left resource pane.

  3. Select the **Subaddress** tab.

  4. Select the **SA10** icon in the left window.

  5. Select the **Tx** button in the upper right corner (choice is Tx or Rx).

  6. Check the **Enable** box.

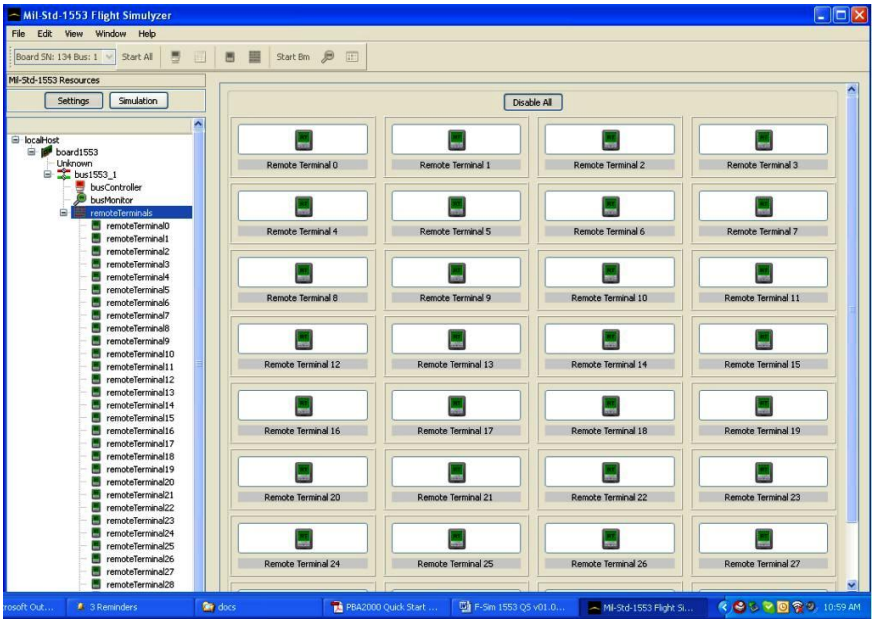
As a shortcut, it is sometimes easier to turn on all Remote Terminals and their subaddresses.

- To Enable All Remote Terminals and Subaddresses:

  1. Select the **remoteTerminals** resource in the left resource pane.

  2. Select the **Enable All** button at the top of the remote terminal display.

Figure 6.2-II - Enable All



7.3 Saving Remote Terminal Setup Information

The Remote Terminal setup information can be saved as either an xml file or a binConfig type file. If you highlight the **remoteTerminals** in the resource window, import and export buttons appear in the lower right hand corner.

Clicking the **Export** button will enable you to save the setup configuration of the Remote Terminals. The xml file can be edited using any xml browser/editor. The schema of the xml file is defined and documented.

The **Import** button enables you to import the Remote Terminal setup information.

7.4 Starting the Remote Terminal(s)

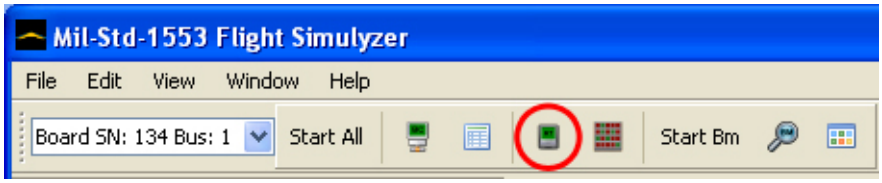
- To start the Remote Terminal simulation:

  1. Press the **Simulation** button. The 1553 resources screen enables you to start the RT's by doing one of the following:

     - Right click on **remoteTerminal** in the resource pane, and choose **Start RT's**.

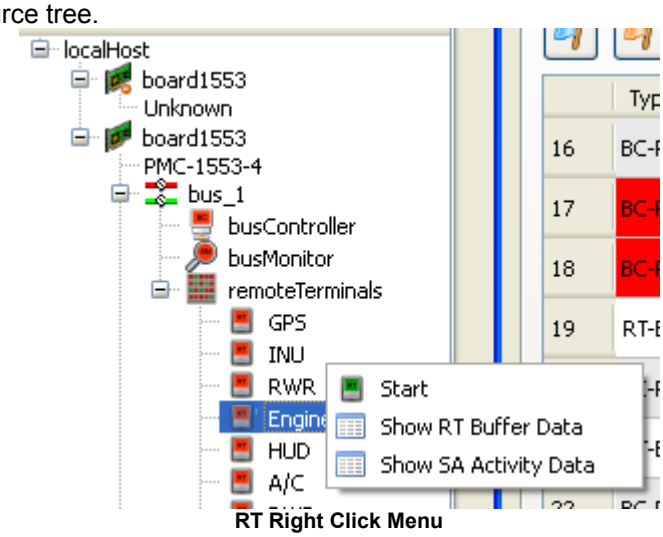
     - Click on the **Start RT** icon in the Menu Bar, shown in the red circle below.

Remote Terminal Icon



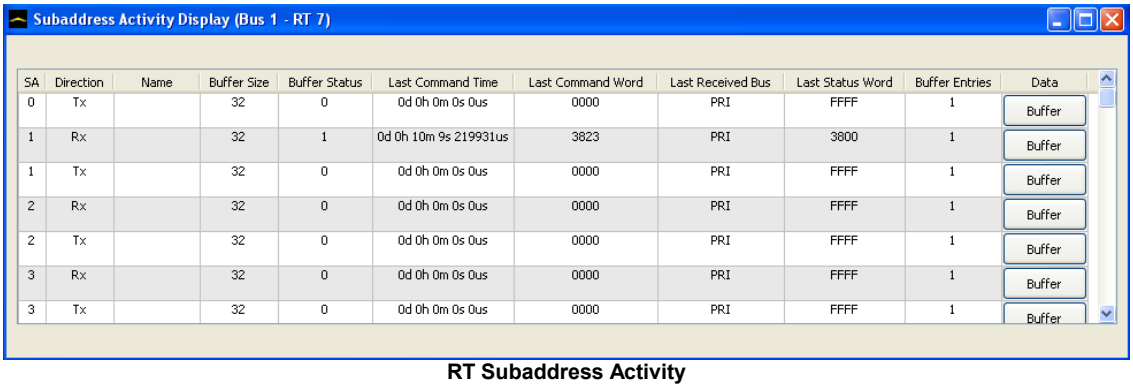
7.5 Operating the RT's

Each of the configured Remote Terminals can be individually controlled by right clicking over the RT in the resource tree.



RT Right Click Menu

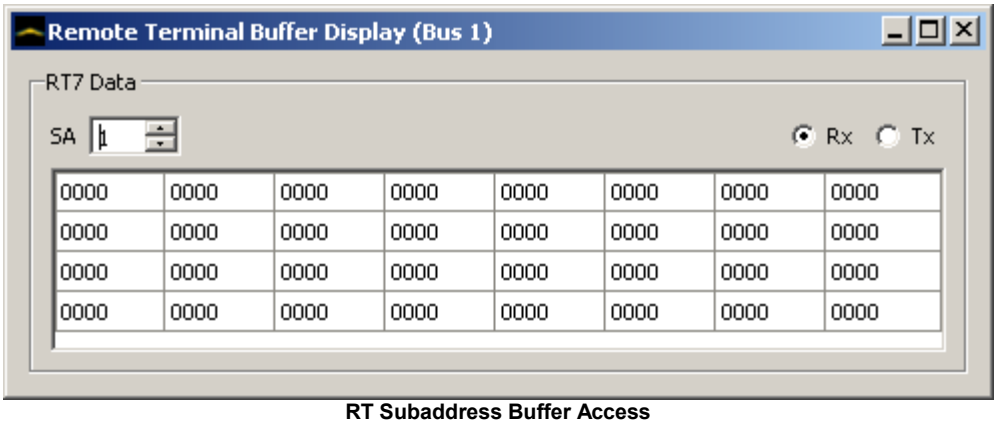
Each RT can be individually stopped or started from the RT Right Click menu.
The transfers set up on an RT can be viewed via the SA Activity Data option:


Subaddress Activity Display (Bus 1 - RT 7)
SA Direction Name Buffer Size Buffer Status Last Command Time Last Command Word Last Received Bus Last Status Word Buffer Entries Data
0 Tx 32 0 0d 0h 0m 0s 0us 0000 PRI FFFF 1 Buffer
1 Rx 32 1 0d 0h 10m 9s 219931us 3823 PRI 3800 1 Buffer
1 Tx 32 0 0d 0h 0m 0s 0us 0000 PRI FFFF 1 Buffer
2 Rx 32 0 0d 0h 0m 0s 0us 0000 PRI FFFF 1 Buffer
2 Tx 32 0 0d 0h 0m 0s 0us 0000 PRI FFFF 1 Buffer
3 Rx 32 0 0d 0h 0m 0s 0us 0000 PRI FFFF 1 Buffer
3 Tx 32 0 0d 0h 0m 0s 0us 0000 PRI FFFF 1 Buffer

RT Subaddress Activity

This dialog shows simulated Rt Subaddress status and allows individual access to Subaddress transfer buffers for reading/writing data.

The Rt Buffer Data option gives direct access to all Rt Subaddress transfer buffers:



RT Subaddress Buffer Access

8 CHRONOLOGICAL BUS MONITOR

The main functions of the Chronological Bus Monitor (BM) are listening and capture all the information, including errors, on the 1553 databus.

The BM is passive and collects data for real-time or post capture analysis. The BM can store all or portions of traffic on the bus, including electrical and protocol errors. BMs are primarily used for instrumentation and data bus testing. Up to 10 triggers are provided which can be used in any combination to identify/capture specific command/status/data words or error conditions detected on the bus or start capture upon an external trigger received via an external digital input. Filters are provided to command the BM to ignore specific RTs or Subaddresses (Tx, Rx or both directions).

The **default** BM setup is set to **trigger on any data word or error received on the bus**.

Setup of the Bus monitor is not required if you just want to capture all 1553 databus activity.

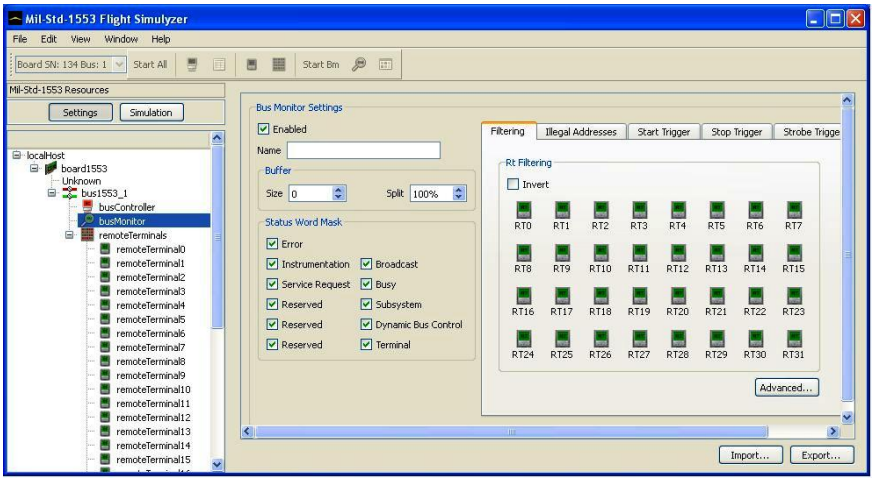
8.1 Bus Monitor Filter Setup

- To setup the Bus Monitor Filters:

  1. Highlight the **busMonitor** in the right resource pane.

  2. Select the **Filtering** tab in the right **Bus Monitor Settings** pane.

Bus Monitor Settings

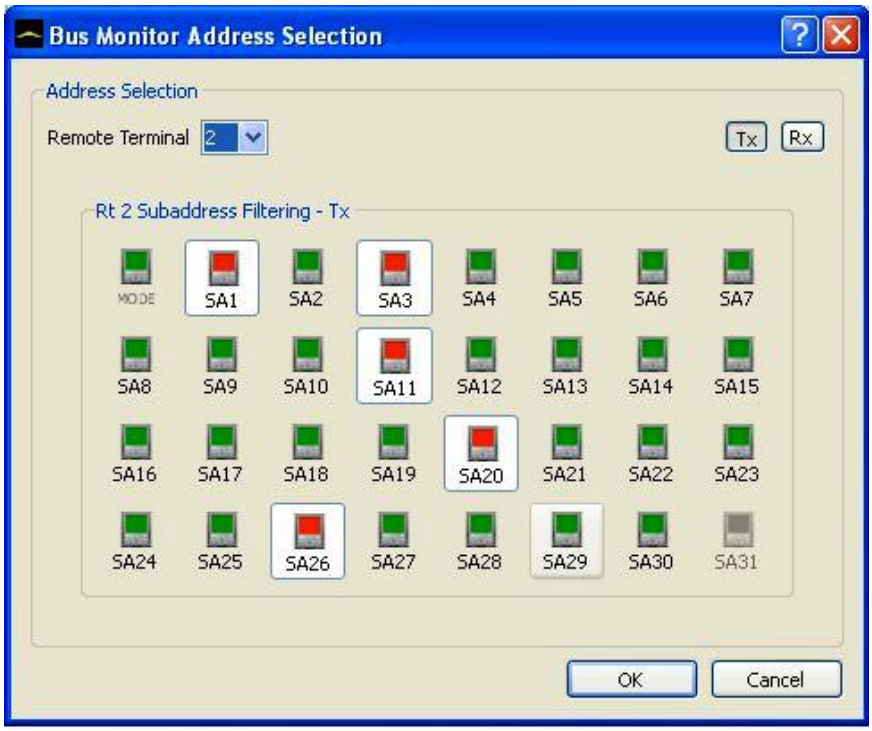


The **default** is enabling **all of the RTs to be captured**.

The **Invert** box will invert the values of the RTs (i.e. from captured to non-captured state).

Select any RT and the **Advanced** button to further select capture of RT subaddress from Tx and Rx, or both.

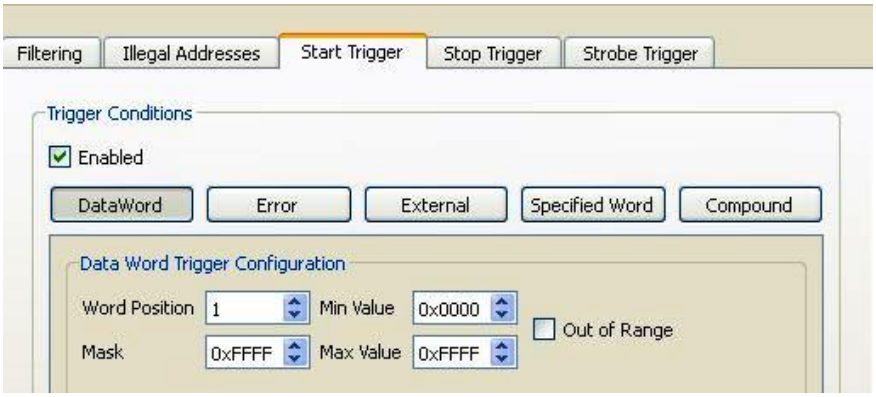
Bus Monitor Address Selection



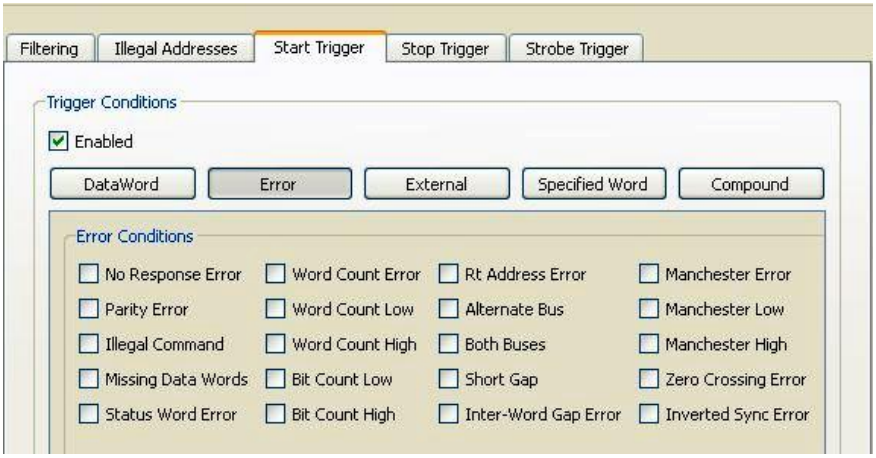
8.2 Choosing and Configuring Start/Stop Triggers

The **Start Trigger** and **Stop Trigger** tabs in the **Bus Monitor Settings** pane enables you to configure trigger conditions that may be used to start or stop the collection of data by the Bus Monitor. There are four types of trigger conditions that may be defined. They are:

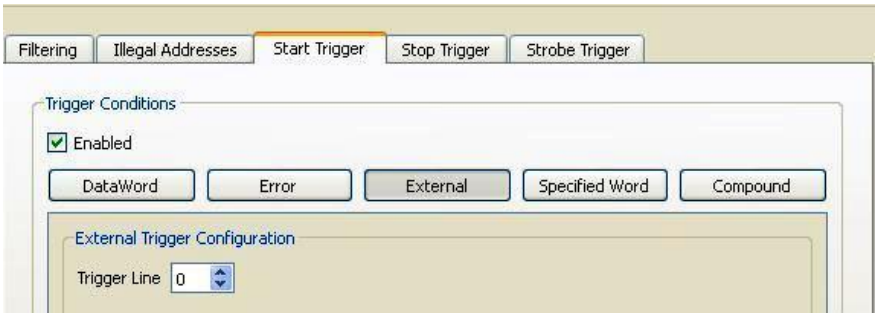
- Data Word: selecting a dataword, or a portion of a dataword, or an out of range value as a trigger condition to the Bus Monitor.



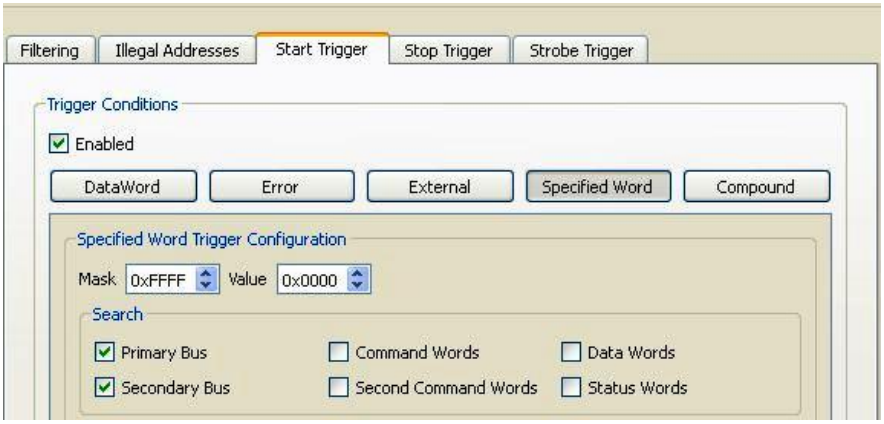
- Error: selecting an error(s) as a trigger condition to the Bus Monitor.



- External: selecting an external digital input as a trigger condition to the Bus Monitor.



- Specified Word: selecting an exact match of a word on the 1553 databus as a trigger condition to the Bus Monitor.



The **Compound** tab is used to define multiple triggers linked together in an "and" condition.

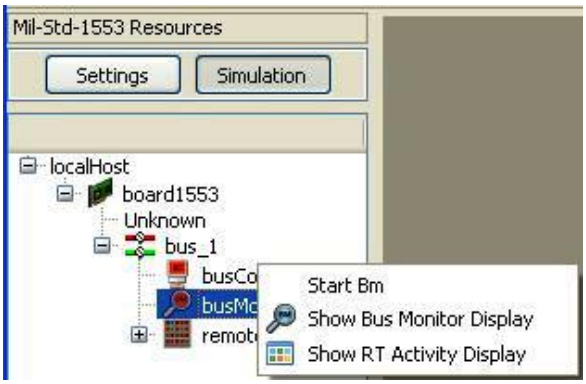
The **Strobe** tab is used to define trigger conditions from data on the 1553 that result in an output strobe over a specified discrete.

8.3 Starting the Bus Monitor

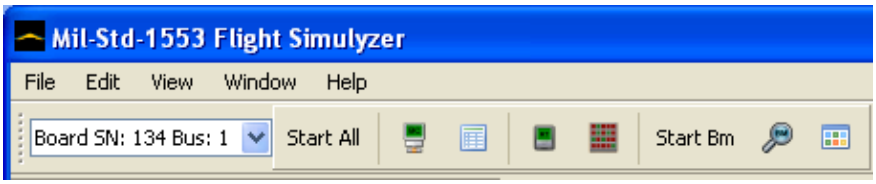
- To start the Bus Monitor:

  1. Press the **Simulation** button. The 1553 resources screen enables you to start the Bus Monitor by doing one of the following:

     - Right click on **busMonitor** in the resource pane, and choose **Start BM**.



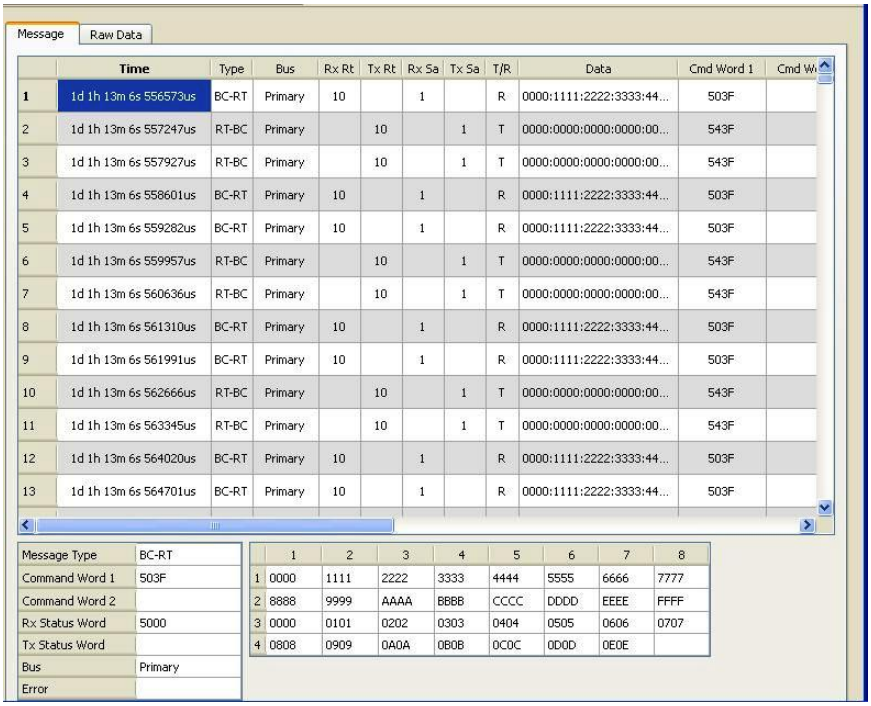
     - Click on the **Start BM** icon in the Menu Bar.



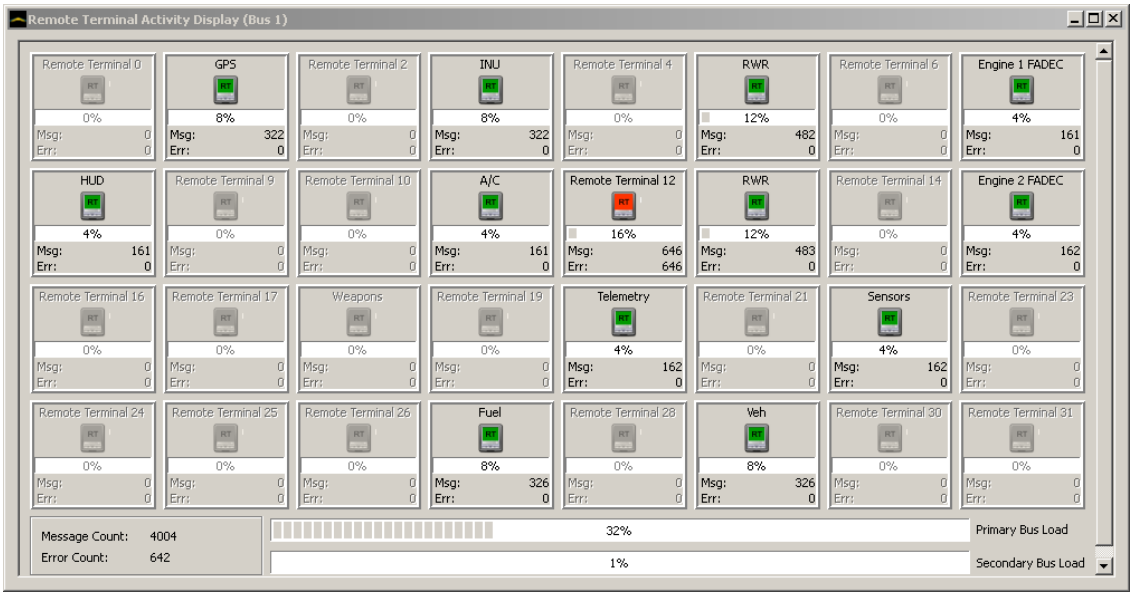
Once the Bus Monitor is started, you can look at the activity of all the RTs on the 1553 databus by selecting the **Show RT Activity Display**.

To enable the Chronological Bus Monitor, simply select the **Show Bus Monitor Display** or use the icon from the toolbar.

Chronological Bus Monitor Display

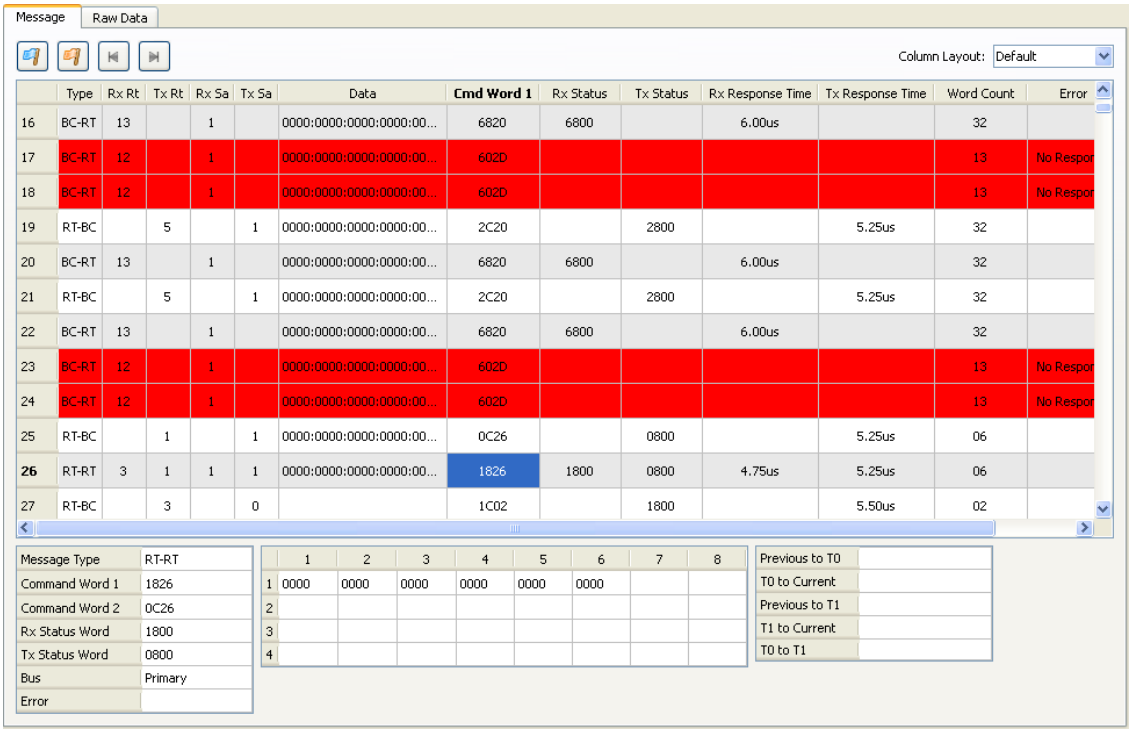


The Bus Monitor also provides an RT Activity display which depicts the current status of the active RT's detected on the bus. This display may be accessed by selecting **Show RT Activity Display** from the Right-click menu for the **busMonitor** in the resource tree. This display is also accessible via a toolbar button.



8.4 Bus Monitor Table

The Bus Monitor Table provides the user with an easy to read data layout and several options for viewing and navigating data:

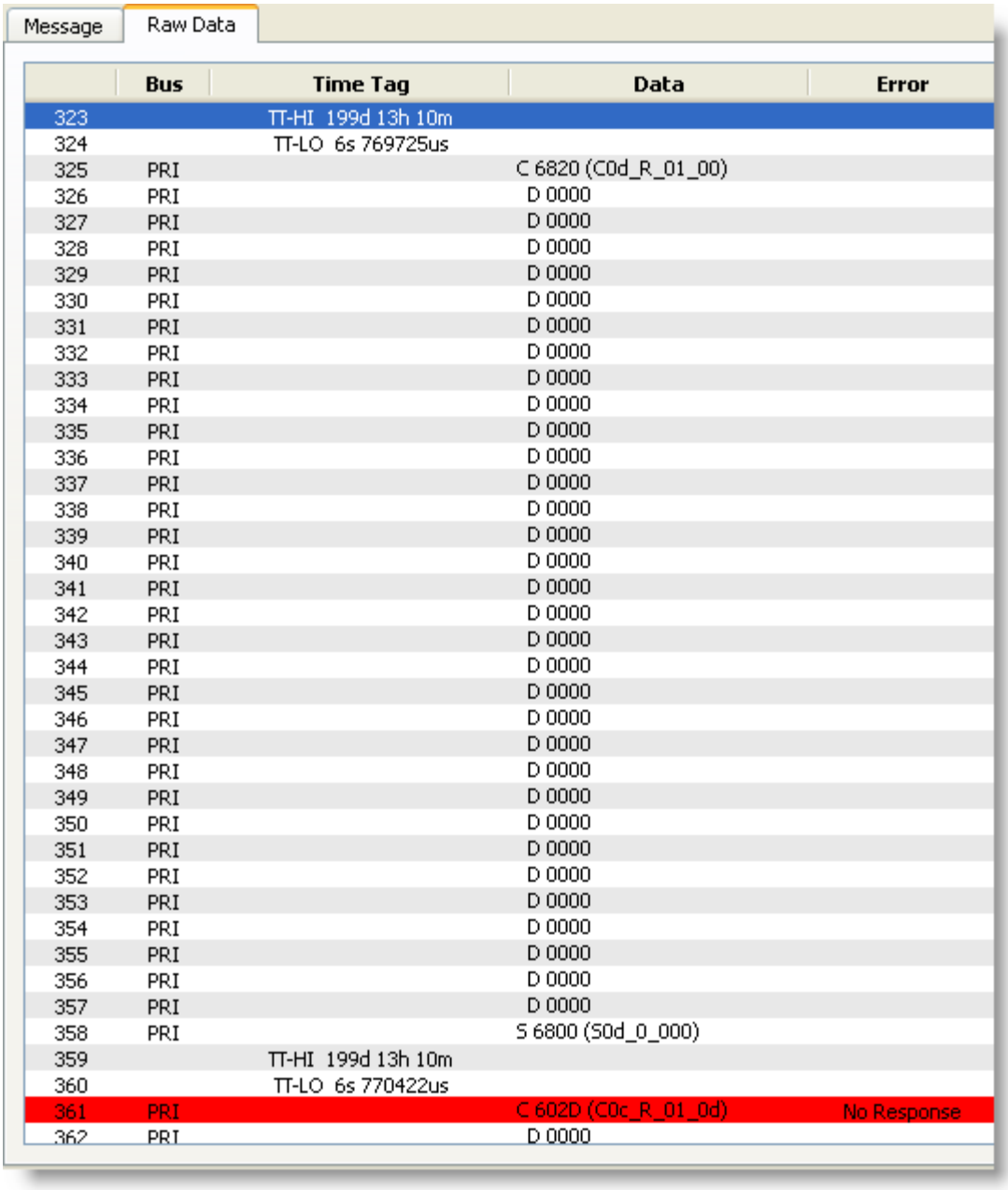


- Data is sorted in the table by timestamp and the table provides various data columns that can be hidden/shown. To show/hide a column, right click on any column header and check/ uncheck
  the desired columns. When done, click anywhere off the menu and the columns will update.

Column layouts can also be created to store favorite views, using the Column Layout drop down menu.

- The flags in the upper left portion of the table (as well as the right click menu) will allow setting a T0 and a T1 marker that indicates the time delta between selections (bottom right).
- The left and right arrow keys allow jumping between Start triggers in the table.
- Each message (when selected) is shown in a break down table (bottom left and bottom middle), that shows message control data as well as data payload.

Selecting the Raw Data tab displays the following table:



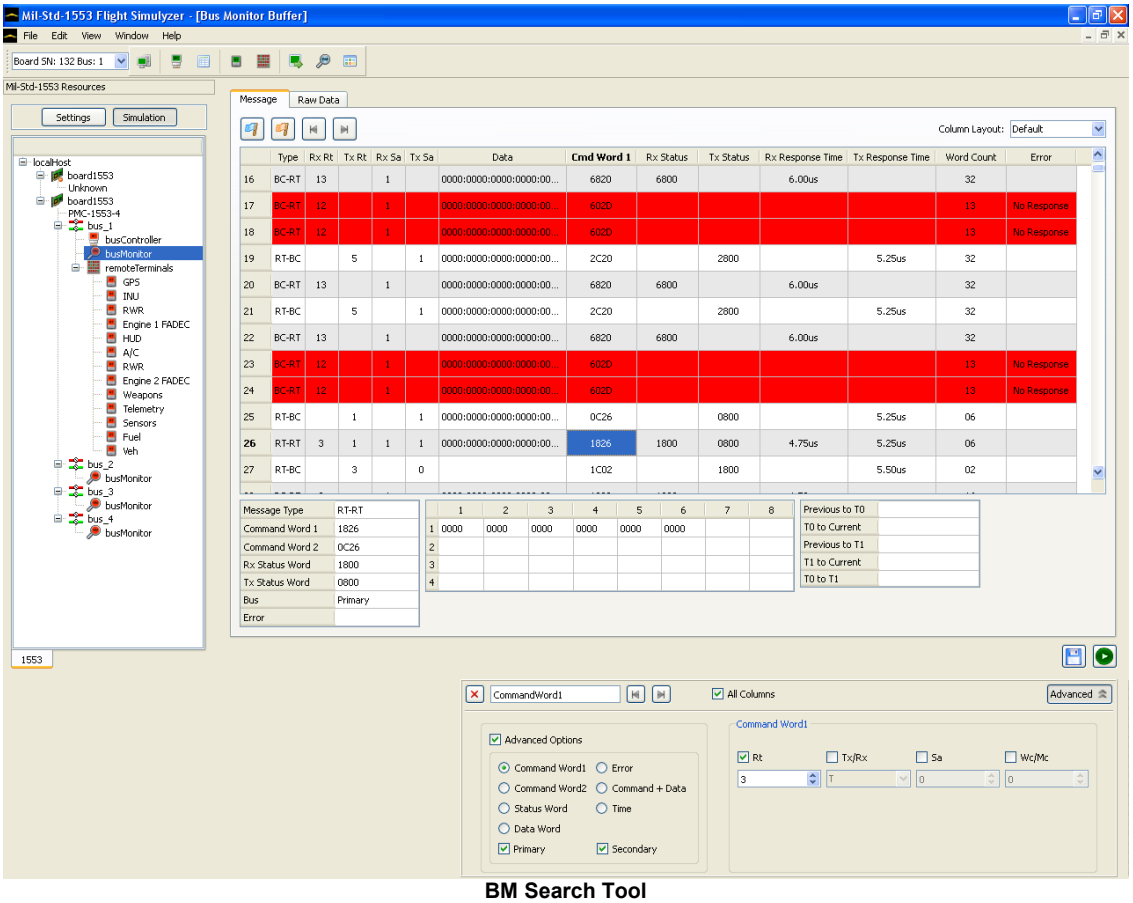
The Raw Data table shows the same data in a data word format. This view allows viewing network specific data, such as which network each word was received upon.
This view also shows the word at which errors were detected during data capture. Clicking between the two data views is synchronized in order to easily provide a means to move back and forth between the views for analyzing specific messages.

8.4.1 Bus Monitor Capture Searches

The Bus Monitor Capture display is searchable.

Standard Data Table

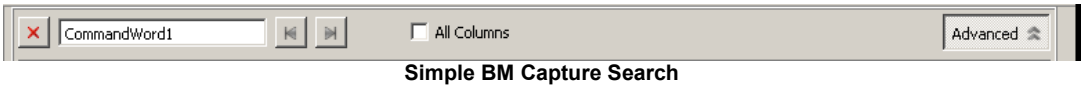
- To access the Search Tool used to search the BM capture data:
  1. Select Edit | Find from the menu (or Ctrl+F). This will cause the Search Tool to appear at the bottom of the Flight Simulyzer window. Note that the search tool is only available when F-SIM is in Simulation mode and the Bus Monitor table is the currently active window.



BM Search Tool

The search tool provides many options to execute easy searches of the captured data.

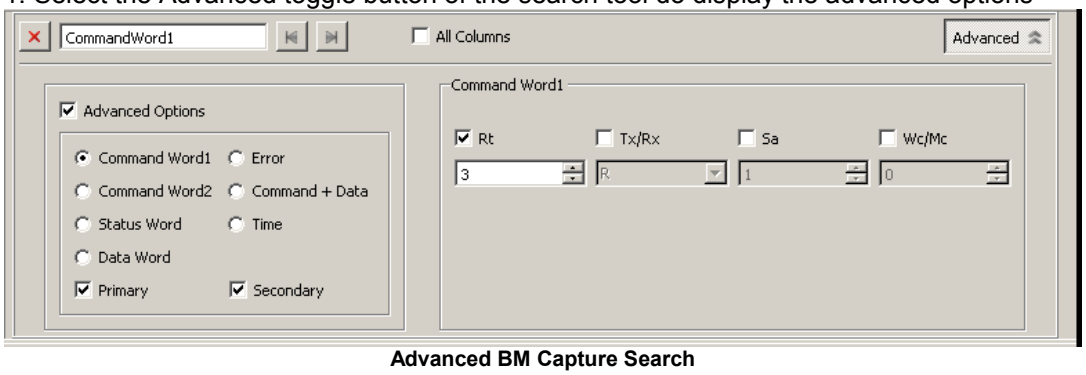
- To search a column of the capture display for a value:
  1. Select the column header or a cell in the desired column.
  2. In the search tool edit box, enter the value to search for



Simple BM Capture Search

  3. Press the arrow buttons to search forwards and backwards for the value.

- To execute a complex capture search:
  1. Select the Advanced toggle button of the search tool do display the advanced options



Advanced BM Capture Search

  2. Select the **Advanced Options** check box
  3. Select the bus transfer field to search. Possible fields are:
     - Command Word1/Word2
     - Status Word
     - Data Word
     - Error
     - Command + Data
     - Time
  4. Enter the data/criteria to search for.
  5. Optionally collapse the advanced search data by clicking the advanced button again
  6. Press the arrow buttons to search forwards or backwards

Raw Data Table

Raw data searches provide simple search functionality only, jumping to specific values found in the table.

- To access the Search Tool used to search the BM capture data:
  1. Select Edit | Find from the menu (or Ctrl+F). This will cause the Search Tool to appear at the bottom of the Flight Simulyzer window. Note that the search tool is only available when F-SIM is in Simulation mode and the Bus Monitor table is the currently active window.

  2. Enter the search term, optionally check the search All Columns checkbox, and then click the forward or back buttons.

To hide the Search Tool, press the escape button or click the red X in the left hand corner of the dialog.

9 NOTES

9.1 Terms

Broadcast:	Commands sent to multiple RT's at once. The RT's are responsible for distinguishing between broadcast and non-broadcast command messages An RT address of 11111 (31) indicates a broadcast message
Data Buffer:	An area of memory on the 1553 device (global RAM) assigned by the programmer to accommodate 1553 transfer(s) to/from the BC or RT (2047 data buffers available)
Driver Command:	Command used by the AIT Target Software to control the 1553 device
Dual Stream:	Indicates the AIT 1553 board supports two dual redundant MIL-STD-1553 data streams
FLASH:	Page-oriented electrical erasable and programmable memory intermessage gap the time between 1553 message transmissions with a minimum gap time, as specified in MIL-STD-1553, of 4.0 microseconds
Interrupt:	A signal from a device attached to a computer or from a program within the computer that causes the main program that operates the computer (the operating system) to stop and figure out what to do next
RT Monitoring:	In this mode, the RT will capture RT message data on a subaddress level without affecting bus traffic (i.e. without generating a response on the bus). This mode is used to monitor non-simulated "external" RTs.
Major Frame:	Sequence of minor frames defined for transfer (max 64 minor frames in a major frame)
MIL-STD-1553:	Military specification defining a digital time division command/response multiplexed databus
Minor Frame:	Sequence of 1553 transfers (max 128 transfers defined in a minor frame)
Mode Code:	Unique five bit codes that are sent to specific RT's to check their

status, control their operation and manage the bus.

Response Time:	The time between the BC Command/Data word and the RT Status word
Response Timeout:	The maximum time the Bus Controller will wait for a Status word
Value:	Response from the RT before indicating a "Response Timeout"
Single Stream:	Indicates the AIT 1553 board supports one dual redundant MIL-STD-1553 data stream
Status Word:	1/2 For RT-to-RT transmissions, Status Word 1 is the status word sent by the transmitting RT, Status Word 2 is the status word sent by the receiving RT
Strobe:	A strobe is a signal that is sent that validates data or other signals on adjacent parallel lines
Transfer Type:	BC-to-RT, RT-to-BC, RT-to-RT
Vector Word:	Transmitted by the RT when requested by the BC with the Mode Code command "Transmit Vector Word" which is Mode code 16, the vector word will contain information indicating the next action to be taken by the BC

9.2 Acronyms and Abbreviations

ADC	Analog to Digital Converter
AFDX	Avionic Full Duplex Databus
ALBI	Local Bus Interface
ANSI	American National Standards Institute
ARINC	Aeronautical Radio, Incorporated
ARM	Advanced RISC Machine
BC	Bus Controller
BIP	Bus Interface Processor
BIU	Bus Interface Unit
CM	Chronological Bus Monitor
cPCI	Compact PCI
CPLD	Coupled
CPU	Central Processing Unit
DAC	Digital to Analog Converter
DC-DC	Direct Current to Direct Current (power conversion)
DIP	Data Interface Processor
DMA	Direct Memory Access
DRAM	Dynamic Random Access Memory
DSUB	D-Subminiature
EDO	Enhanced Data Output
EEPROM	Electrically Erasable and Programmable Read Only Memory
EPROM	Erasable Programmable Read Only Memory
FIFO	First in/First out
FLASH	Page oriented electrical erasable and programmable memory
FPGA	Field Programmable Gate Array
GND	Ground
IEEE	Institute of Electric and Electronic Engineers
IRIG	Inter Range Instrumentations Group
IRIG-B	Inter Range Instrumentations Group Time code Format Type B
I/O	Input/Output
LCA	Logic Cell Array (XILINX - Programmable Gate Array)
LED	Light-emitting Diode
MIL-STD	Military Standard
µsec	microsecond
OWL	Object Wrapper Library
PC	Personal Computer
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect Express
PMC	PCI Mezzanine Card
PROM	Programmable Read Only Memory
PSC	PCI and System Controller
PXI	PCI Extensions for Instrumentation

PXIe	PCI Extensions for Instrumentation Express
RAM	Random Access Memory
RISC	Reduced Instruction Set Computer
RMW	Read-Modify-Write
RS-232	Recommended Standard No.232 (US-Norm)
RT	Remote Terminal
RTPTP	Remote Terminal Production Test Plan
RXD	Received Data
SDK	AIT's Software Development Kit
SIMM	Single Inline Memory Module
SRAM	Static Random Access Memory
SSRAM	Synchronous Static Random Access Memory
TBD	To be determined
TCP	Time Code Processor
TTL	Transistor-Transistor Logic
TXD	Transmitted Data
UART	Universal Asynchronous Receiver and Transmitter
USB	Universal Serial Bus
VME	VERSAmodule Eurocard
VME64	VME 64bit extension
VXI	VME Extensions for Instrumentation
XMC	PCI Express Mezzanine Card